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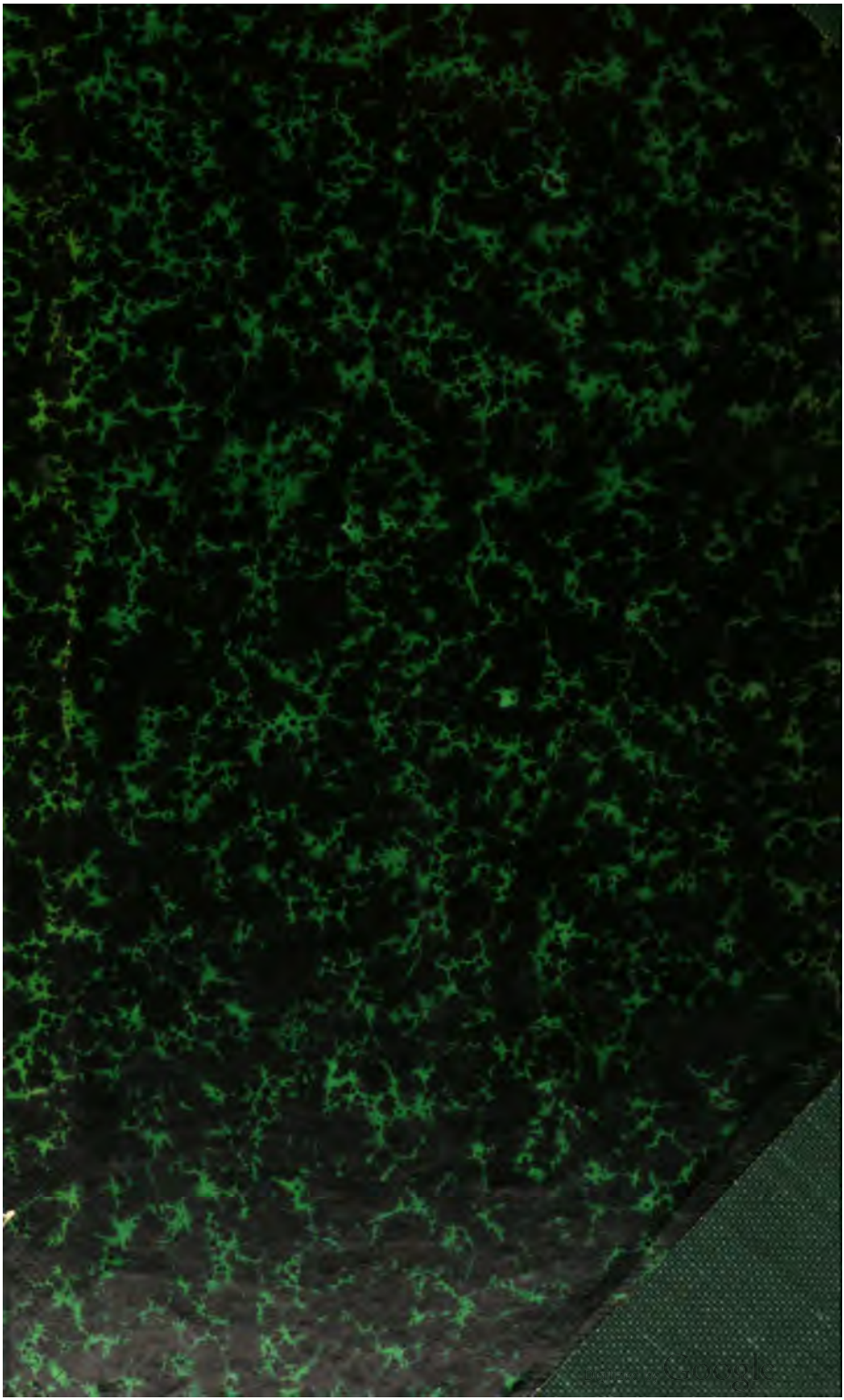
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The Norfolk and Norwich Naturalists' Society has for its objects:—

1. The Practical Study of Natural Science.

2. The protection, by its influence with landowners and others, of indigenous species requiring protection, and the circulation of information which may dispel prejudices leading to their destruction.

3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.

4. The record of facts and traditions connected with the habits, distribution, and former abundance or otherwise of animals and plants which have become extinct in the County; and the use of all legitimate means to prevent the extermination of existing species, more especially those known to be diminishing in numbers.

5. The publication of Papers on Natural History, contributed to the Society, especially such as relate to the County of Norfolk.

6. The facilitating a friendly intercourse between local Naturalists, by means of Meetings for the reading and discussion of papers and for the exhibition of specimens, supplemented by Field-meetings and Excursions, with a view to extend the study of Natural Science on a sound and systematic basis.

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OF THE

Norfolk and Norwich

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Presented to the Members for

1899–1900.

VOL. VII.—PART I.

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To Balance from last year	52	1	5
To Subscriptions:—	£	s.	d.
1 for 1896—97	0	5	0
9 ,, 1897—98	2	5	0
18 ,, 1898—99	4	10	0
157 ,, 1899—1900	39	5	0
14 ,, 1900—1	3	10	0
1 ,, 1901—2	0	5	0
1 ,, 1902—3	0	5	0
	50	5	0
,, Additional payments	0	8	0
,, Sale of *Transactions*	5	16	7
,, Sale of Bookcase	6	0	0
	£114	11	0

Cr.	£	s.	d.
By Fletcher and Son, Limited, *Transactions*, 1898—99	41	12	6
,, Illustrations to *Transactions*	7	12	1
,, Stationery, Circulars, Postage, &c.	9	10	6
,, Insurance	0	9	0
,, Sir Thomas Browne Memorial Fund	2	2	0
,, Year Book of Scientific Societies	0	6	0
,, New Book Case	36	0	0
,, Door Keeper at Castle Museum	1	0	0
,, Assistant Secretary's Salary	5	0	0
,, Balance at Bank	10	18	11
	£114	11	0

M.

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	£	s.	d.
To Balance in Norfolk and Norwich Savings Bank ...	101	12	11
,, One Composition for Life Membership	4	0	0
,, Interest to November 20th, 1899	2	10	6
	£108	3	5

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By Balance in Norfolk and Norwich Savings Bank ...	108	3	5
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Examined with vouchers and found correct,
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List of the Publications received by the Society as Donations or Exchanges from March, 1899.

AFRICA, South-west, Birds of. MS. C. J. Anderson. Nos. 1 and 2., 1869. *From Mr. J. H. Gurney, F.Z.S.*

AGRICULTURE, The Code of. Sir John Sinclair, Bart. 1817. *From Mr. J. H. Gurney, F.Z.S.*

ARCTIC Birds and their Geography. MS. Middendorff. *From Mr. J. H. Gurney, F.Z.S.*

ARCTIC Cruise of the Revenue Steamer Corwin, 1881. Capt. Hooper's Report. *From Col. H. W. Feilden.*

AUSTRALIA, Entomology of. G. R. Gray. Genus Phasma, Monograph of. London, 1833. *From Mr. J. H. Gurney, F.Z.S.*

BARROW Naturalists' Field Club. Annual Report. Vol. xiii. *From the Club.*

BATH Natural History and Antiquarian Field Club, Proceedings of the. Vol. ix. no. 2. *From the Club.*

BEDFORD, Late Duke of. Letter from Dawson Turner to. Glasgow, 1840. *From Mr. J. H. Gurney, F.Z.S.*

BERWICKSHIRE Naturalists' Club, History of. Vol. xvi., 1896—98. Alnwick, 1899.

BIRDS, Hand List of. Vol. i. R. Bowdler Sharpe, LL.D. London, 1899. *Presented by the British Museum.*

BIRD Life in an Arctic Spring. Dan. Meinertzhagen and R. P. Hornby. London, 1899. *From Mr. J. H. Gurney, F.Z.S.*

BIRDS of Devon. W. S. M. D'Urban, F.L.S. and Rev. Murray A. Mathew, M.A., F.L.S. London, 1895. *From Mr. W. S. M. D'Urban.*

BIRDS, Natural History of. 2 Vols. Bungay, 1815. *From Mr. J. H. Gurney, F.Z.S.*

BRITISH Association. Report of Meeting at Dover, September, 1899. London, 1900. *From the Association.*

BRISTOL Naturalists' Society. Proceedings for 1898. *From the Society.*

BRITISH Zoology. Thos. Pennant. 4 Vols. London, 1768. *From Professor Newton, F.R.S.*

BULLETIN of the Geological Institution of the University of Upsala. Vol. iv. part 1. *From the Institution.*

CAITHNESS, Contribution towards a Flora of. No. 3. Arthur Bennett, F.L.S. *From the Author.*

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CARDIFF Naturalists' Society. Report. Vol. xxxi., 1898—99.
From the Society.

CATALOGUE Systematique du Cabinet d'Ornithologie et de Quadrumanes de C. J. Temminck. Amsterdam, 1807.
From Professor Newton, F.R.S.

CLEVELAND Naturalists' Field Club. Proceedings 1896—7—8. Middlesbrough, 1899. *From the Club.*

COCOONS, On Variation in the Colour of, etc. W. Bateson, M.A. 1891. *From Professor Newton, F.R.S.*

COMPENDIUM of Zoology of British Isles. W. Turton, M.D. 1807.
From Mr. J. H. Gurney, F.Z.S.

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ADDRESS.

Read by the President, MR. J. T. HOTBLACK, *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-first Annual Meeting, held at the Norwich Castle-Museum, March 27th, 1900.*

LADIES AND GENTLEMEN—The year for which you elected me your President has quickly come to an end, as indeed all years appear to do when one has reached middle life and is actively engaged in business. I felt at the time you chose me for this office that something of an exception was being made in my case, and that it was not usual for this Society to be presided over by one whose time was so largely taken up by commercial pursuits. We have many members with much leisure and great ability, and some few with most exceptional scientific attainments, and it is from them that your Presidents are generally taken.

Yet I think it well that business men should be encouraged by such Societies as ours to think of something sometimes beside the state of the Money and Labour Markets, and the difference between buying and selling. To me, since my earliest years, it has been a constant delight to enquire into anything curious which I chanced to see, and I am now frequently able to recall things which I have seen and wondered at years since when I used to travel about the country for business both further and more frequently than I do now—for instance, a peculiar geological formation being mentioned, perhaps as close as the red chalk at Hunstanton, or as far as the granite rocks of the Western Hebrides—I am able to recall the time when being in their locality for business I was able to inspect and wonder at them without any cost of money, or time; but I regret that, that same business has taken me from home, even

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in the past year, so as to make it quite impossible for me to attend all the meetings. If this Society depended for its success upon the exertions of its President I should never have ventured to take the office; but it is not so, and though the formal papers may not be quite so many as they have been in some other years, still I feel that there has been no meeting during the past year which has not been thoroughly interesting to those who attended it.

In referring briefly to these meetings I have omitted the mention of those papers which are printed *in extenso* in the 'Transactions.'

At the first meeting it was decided that a letter be sent to the Members of Parliament for the City and County asking for their general support to the principle of the Wild Birds Protection Act, 1899. I think I am right in saying that every one of those gentlemen replied most favourably.

At the same meeting a section of an Oak, from Messrs. Wright and Turner, of Mountergate Street, was exhibited by myself. It shew a very peculiar growth of "Sap" such as Messrs. Wright and Turner, with their very large experience, say they have never met with before. The tree seems to have been injured in some way so that the sap and bark decayed almost, if not quite, round a considerable length of the trunk, then a new layer of healthy sap seems to have grown over the decayed part, at least it shows a great effort of nature to heal an injury. The section is now in the Castle-Museum.

The next meeting was held on 30th May, when there was on the table a tooth of *Elephas antiquus*, which was very plainly marked with glacial scratchings, and was considered by the late Mr. John Gunn as one of his pet specimens, and which Mr. Reeve secured at the time of Mr. Gunn's decease. Teeth, or, indeed, any organic remains showing glaciation, being extremely rare, the interest in this specimen is not only that it shows the effect of the ice action, but also proves the animal to have lived in glacial or pre-glacial times, it being generally recognised as a distinct species intermediate between Meridionalis and Primigenius, the former being the older form of the Elephant, and the latter being the Mammoth of the Siberian finds. I was able to compare and

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explain the difference between the teeth of the three species, having on the table other specimens from the Museum collection, and also one of Meridionalis, obtained by myself (with many other bones of the same species) from the iron-pan of the Forest-bed at Mundesley. I also emphasised in my remarks the fact that the Forest-bed had nothing directly to do with any forest—it was in no sense the bed of a forest—but was without any reasonable doubt an estuarine deposit—part, perhaps the extreme western edge, of the estuary of that mighty river which then received the water of the present Rhine, and of all the rivers between it and what is now the East Coast of Norfolk, when the county formed part of the Continent of Europe.

In July, an excursion to Costessey and Ringland was much enjoyed by sixteen members and friends.

After the summer vacation our first meeting was held on September 26th, when Mr. Patterson contributed "Some Summer Notes" from Yarmouth. Amongst other interesting occurrences he alluded to the immense number of Tipulæ, or Crane-flies, to be seen this summer. The experimental fishing trip of the "Teal" to the Bay of Biscay, which brought home 50 Doreys, 100 Sea-bream, three trunks of Piper-gurnards, and 500 Hake, is worthy of record, as showing the character of the fish fauna of that region.*

At this meeting I gave an account of my visit to the British Association meeting at Dover, as delegate from this Society, when I attended most of the lectures of the geological section, in addition to the meeting of the Corresponding Societies' Committee, and, of course, the important opening meeting to hear the address of Sir Michael Foster. At the meeting of delegates, the Rev. T. R. R. Stebbing, F.R.S., read a paper on "Underground Fauna." There are not many representatives of this fauna in Britain, but I was able to inform the meeting that Dr. Harmer, of Cambridge, had recorded the occurrence, in Norfolk, of one which came under this heading, viz., the Well-shrimp *(Niphargus)*.

* The trip was not considered financially a success, and the experiment is not likely to be repeated.

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The next meeting was on 31st October, when Mr. J. H. Gurney very kindly took the chair in my absence.

A letter was read from Mr. R. Holt-White, who is about to publish a Life and Letters of Gilbert White, of Selbourne, asking permission to print from the 'Transactions' of this Society the White—Marsham Correspondence. Our excellent friend, Professor Newton, of Cambridge, had also written supporting the request. It is needless to say that such a request so supported was granted. Every Naturalist must feel that too much cannot be done to honour and make known the work of the great Gilbert White of Selbourne.

The last meeting of last year was held on the 28th November.

Miss Barnard exhibited a portion of the stem of a Climbing Bamboo, from Queensland.

Mr. Patterson contributed his Notes for October and November. A number of Grey Plovers were seen in the early part of October. A fine example of the Anchovy, taken in a herring-net on 30th September, was shown, length 7½ ins. Other interesting occurrences were alluded to by Mr. Patterson.

At our January meeting Mr. J. H. Gurney exhibited a live Silky Icterus *(Molothrus bonariensis)* from South America.

Mr. Patterson contributed his interesting "Notes from Yarmouth," for December, 1899, and January, 1900, in which he mentioned that a Short-nosed Sturgeon, 4 ft. long, was brought to the Fishwharf on 23rd November, 1899. Several facts as to bird life were brought under notice by him.

Mr. J. B. Beckett sent some Radiated Trough Shells *(Mactra stultorum)*, many of which have been washed ashore at Gorleston recently.

The second meeting of this year was held on the 27th February, when Mr. H. D. Geldart applied for leave to use the botanical information relating to the County of Norfolk, contained in the Society's 'Transactions,' for the purpose of a new County History, to which he is to contribute the botanical matter. Mr. Geldart explained that he would apply also to the writers of the various papers where they are known. Your President remarked that there

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was probably no one so well qualified as Mr. Geldart to do Norfolk botany.

Mr. Charles Williams, on behalf of Mr. W. S. M. D'Urban, asked the acceptance by this Society of a copy of 'The Birds of Devon,' by Mr. D'Urban and the Rev. M. A. Mathew, in memory of the former connection of Mr. D'Urban's family with the County of Norfolk. The gift was gratefully accepted.

After the reading at our February meeting of Mr. A. W. Preston's "Meteorological Notes for 1899," our old friend Mr. Dix (whom we were all very pleased to see well enough to be with us again) exhibited his rain chart of the monthly fall for a hundred years, which begins and will end with the century. Mr. Dix explained that a large proportion of the records were actually taken by himself, and drew attention to the fact that the rainfall for the past January and February is the largest in those two months for over ninety years.

At a meeting of your Committee, held at the Norfolk and Norwich Library on the 12th June, new book-cases were ordered to be fitted in the room set apart there for our use at a cost of £36. These are now complete, and the books all in place.

During the year we have received donations of books from Mr. Gurney, Professor Newton, Dr. Harmer, Mr. H. G. Barclay, Mr. G. F. Buxton, and Colonel Feilden.

By our Treasurer's report our finances will be found to be in a satisfactory state.

We have lost by death and other causes fourteen members during the year. We have gained eight new ones, making our present number 250.

Our deaths have been four, all of them notable members.

Sir James Paget, F.R.S., born in Great Yarmouth, 11th January, 1814, was a man of world-wide reputation, but we think of him most as an eminent local Naturalist who to the last took a lively interest in everything connected with the county of his birth.

Mr. J. B. Bridgman had been an active member of our Society since its formation in 1869. He was President in 1875-6, and

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made frequent valued contributions to our 'Transactions,' being no mean authority in his own particular department.

Mr. John Cordeaux, though living in an adjoining county, was a valued member of our Society, being a very eminent Naturalist. His earliest publication was on the Birds of the Humber District, which has long remained the standard work on that subject. He was also an enthusiastic botanist and archæologist.

Mr. R. H. J. Gurney, of Northrepps Hall, being a son of so eminent a Naturalist, could not help but be a Naturalist himself. He was more than once a kind donor to the Museum, which I fear has lost a good friend by his too early decease.

Memoirs of Sir James Paget, Mr. John Cordeaux, and Mr. J. B. Bridgman will be prepared by Mr. Southwell, and one of Mr. R. H. J. Gurney by Mr. Bidwell.

I am not sure that the custom of expecting a paper from a retiring President as part of his Address is a good one. I rather think that a review of the year's work of the Society should be sufficient both for your President to read and you to listen to at one meeting. The paper I now propose to read, if published at all (for it is in parts more controversial than our papers generally are), should, I think, following Mr. Gurney's last year's precedent, be printed as a separate paper.

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I.

THE STONES ON MUNDESLEY BEACH.

By J. T. Hotblack.

Read 27th March, 1900.

I have selected a very simple subject for my Presidential Address, as befits one who pretends to no very special knowledge upon any subject. I have chosen the Stones on Mundesley Beach; what are they, whence came they, how came they, and what may we learn from them? Of course, what I have to say of the stones at Mundesley would apply generally to the whole of the Norfolk and Suffolk Coast, but, as every Naturalist knows, it is most desirable to have a precise locality. I think that, kicked and thrown about as they are by many of us in our idle moments when spending our restful time (here as at other seaside resorts), the stones on the beach may well awaken enquiry in the minds of others as they did long since in my own.

What are they? The great bulk are, of course, flints from the chalk, and at Mundesley many of them have but recently been washed straight out of the chalk, there being near Mundesley a considerable exposure of chalk on the beach, from which at every tide fresh flints are being washed, and this chalk, being very high chalk, quite the highest (*i.e.*, the most recent) in this part of England, is very full of flint. Still, I think most of the flints now on the beach have come out of the boulder clay, of which, mixed with the glacial drift, there is very much in the cliffs hereabouts, and into which they were ground during the glacial period, probably from the district immediately to the north. These flints from the boulder clay and glacial drift include most, if not all, of those of the pink or red variety of which you will see so many on the Mundesley Beach; some writers have, as I think, most improperly described them as half-made carnelians. If I am right

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in what I shall say later about carnelians, these pink and red flints have nothing to do with those very different stones, but are just flints and nothing more, and I think that we need only visit the present red chalk, or marl, or gault, or whatever it is (for it has been very much discussed and variously described), at Hunstanton to see that they need not have come very far, and probably they have not come far, for Mr. Jesson, of the Danish Geological Survey, states that the pink flints of the English Drift are not known in Denmark, which I think proves that they did not come like so much else in the drift, from the farther North.

There is yet another source from which some of the flints have come, including, perhaps, a few of the red or pink, the iron-pan of what is known as the Forest-bed, of which there are several exposures at Mundesley, and about which I shall have something to say later in this paper.

Having disposed of the flints which are, as it were, native to the district, we come to a vast assortment of rocks which are quite foreign to this part of England, some of them such as the well-known rhomb-porphyry, being almost certainly of Scandinavian origin.

What an assortment of these rocks, either foreign or from the North of England or from Scotland, do we find.

There are the granites to represent the Plutonic or oldest rocks in such variety that it seems quite impossible to say whence they may all have come or how far they must have travelled.

Then we have the Metamorphic Rocks represented by the gneiss, mica-schist, and hornblend-schist, all of which have come from the country north of the Forth and Clyde; much of the quartzite, of which there are so many specimens, and which, being native to so many districts, we cannot at all say how far they may have come, also belongs to this series.

Then there are the Trap Rocks, represented by basalt, greenstone, serpentine, porphyry, &c., in considerable variety.

How have all these igneous and volcanic rocks come here, for it is certain that there is not, and never was since the earliest ages of the world, an outcrop of any one of them within many miles? We must go at least beyond the region covered by the chalk for such an outcrop to be possible.

There are two agencies which I know of, and of these the one

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I shall mention first is by far the most important. Every one will know at once the cause to which I am about to refer, and I can imagine some asking themselves, Where do you want, or where can you find another? Well, wait! The great agency has, of course, been ice, leaving out of account the flints of which, as I have said, some have been washed straight out of the chalk. Almost everything I have mentioned, including most even of the common flints, and perhaps all the pink or red flints owe their presence here to glacial action. Some, as the rhomb-porphyry, have almost certainly come from distant Scandinavia; others, like the red flints, may have come but from neighbouring Hunstanton. What a mighty force must that ice of the glacial period have exercised, whether it were in the form of glacier, iceberg, or ice-sheet; but what is the second agency? I admit it to have been but a small one, but I think it can be found in the waters of that pre-historic Rhine, which brought down flints, stones, and fragments of rock from its banks, attached, perhaps, to the roots of trees which it carried down with its flood, and finally deposited in what we now know as the iron-pan of the Forest-bed, but which was really the bottom of its estuarine mud. Out of this iron-pan these stones are now sometimes washed, and so form a part, if a small one, of the pebbles on our beach.

I have purposely omitted any reference to the aqueous or fossiliferous rocks, which, being much softer, are soon broken up by the action of the sea on the beach, though specimens of them are no doubt washed out of the boulder clay, the glacial drift, and the Forest-bed, and also sometimes, perhaps, out of the crag, of which there are some small exposures hereabouts.

But stay, had I read this paper so far before my children they would have at once objected that I had forgotten and left out all reference to the carnelians and agates, of which they find so many on the beach at Mundesley. No, I have not forgotten these pebbles of pebbles; these pebbles, *par excellence*, the carnelians and agates, I have left them purposely till the last; and what judges those children are of what is and is not a carnelian, even my youngest little girl, when still unable to speak quite plainly, if I had shown her an exceptionally bright pink flint, or a specially clear bit of quartzite, and asked her is this one, would have turned up her little nose with disdain and answered without a moment's

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hesitation, "Dat's not a 'nelian," and she would have been right where some learned geologists have, I think, been wrong, for I have seen it seriously stated that pink flints are an inferior sort of or half-made carnelian or chalcedony; even the great Ruskin, who was no mean geologist, describes in one of his delightfully-written books the pleasure he derived from the collection of pebbles of chalcedony on the beach of one of the South of England seaside towns, and is careful to mention that these pebbles of chalcedony show plainly their organic origin. Of course, those South of England pebbles are of organic origin, and for that very reason, as I contend, they are not chalcedony. In support of my contention I shall have to trouble you with quotations from one or two authorities.

Emanuel says: "The beach pebbles found on the South Coast of England always have the same mixture of colours, clouded brown with black and grey, in some specimens there are fine sections of choanites, proving them to have been formed in the Cretaceous Age, and to be totally different to real agate."

Bristow says: "Agates are found in amygdaloid, a variety of trap rock. Scotch pebbles are true agates, but the stones from the South of England, sold as such, are merely flints from the chalk containing the silicified remains of sponges and other marine bodies."

Again he (Bristow) says: "Of chalcedony, the brown and yellow is called sard; the red is carnelian; the white, and yellowish white, is known as white carnelian," and, he adds, "chalcedony often exhibits parallel or concentric bands or laminæ, when it is called agate."

So far I agree with him, but, he continues, "specimens are found in flints at Houghton Chalk Pits, near Arundel in Sussex, and beautiful specimens of sponges of the cretaceous period, converted into chalcedony, may be picked up on the shore at Worthing and other places on the South Coast of England."

Again he says: "Chalk flints in the gravels in many parts of this county are frequently of a bright red and yellow colour, in fact, converted into agates and imperfect carnelians by long exposure to the sun's heat and light."

It will be seen how completely this great authority contradicts himself.

But what does another writer say of chalcedony? "Various

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theories have been propounded for the purpose of explaining the origin of agate-nodules in the cavities of rock. The cavities themselves are supposed to result from the imprisonment of gas-bubbles whilst the rock was in a molten condition. The nodules have been deemed to result from the crystallisation of silica whilst in solution, or from the driving off of silica from the surrounding rock in a state of vapour, whence it slowly solidified."

I should rather have said that the bubbles were of silica in a state of vapour, which in cooling and solidifying formed crystals in the centre of such geodes as were sufficiently large.

The same author says: "Agate, onyx, and chalcedony are produced almost exclusively in trap." He should have said agate, onyx, and the other forms of chalcedony, for with Bristow I contend that carnelian, sard, onyx, sardonyx, agate, &c., are all forms of chalcedony.

Thompson says: "Chalcedony comprises carnelian, bloodstone, onyx, sardonyx, mochastone, agate, &c.," and it is not at all difficult to say what the &c., comprises.

How has all this confusion arisen? It is, I take it, because—quartz, chalcedony, and flint are each of them almost of exactly the same chemical composition, and they have the same cleavage, lustre, hardness, and specific gravity, and yet the two former are, as I believe, always of igneous origin, while flint we know was formed in quite a different way. There was a very able paper on the Formation of Flints, read by Professor W. J. Sollas, F.R.S., before the last meeting of the British Association. No, I think it a mistake to call flint or stalactites of silica either quartz or chalcedony, the former no doubt have sometimes a beauty of their own, but they could never have been used either for the engraving of seal and intaglios, or the carving of cameos, for which chalcedony, from the earliest ages, has been recognised as peculiarly adapted. There is something in the toughness, quite apart from the hardness, of the whole chalcedony family, which makes every sort most suitable for the carver, graver, or engraver. Sard, carnelian, agate, onyx, sardonyx, &c., are all equally good. I could give any number of quotations from ancient writers extolling their superiority over all other stones for the making of seals, cameos, &c. To-day they are almost exclusively used for the making of seals even in the wholesale trade. Were you to take a flint (however much it

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might have been exposed to the action of the sun) to a lapidary and ask him to have your crest, or even your initials, engraved on it, I fancy he would not be long in telling you that it was not suitable for the purpose.

Streeter says: "In cutting a cameo from carnelian the snow-white layers should be made use of for the figure, the red for the base, and should it have a third layer it would serve for the hair in the figure of the cameo."

He might have added, and, if yet another layer, perhaps for the cap; but the stone with layers, as he describes, would not be properly called carnelian, it would, I should say, be either sardonyx or agate, according to the number of layers; it is only the chalcedony without layers that is properly called carnelian.

The same writer says: "Carnelian was probably chosen by the Greeks and Romans for cameos in consequence of its possessing a beautiful colour and a certain hardness, we shall mention only a few of the many famous specimens. The oldest Greek gems known are in the collection of the Emperor of Germany; one of them is a cameo on which is represented a winged Jupiter appearing to Semele, and the other an opaque sardonyx, on which is engraved a draped figure of Venus. There is a carnelian of the earliest period in the St. Petersburg collection, on which a man's head is engraved with most artistically-arranged beard. The British Museum possesses an example of the second period, viz., a carnelian butterfly carrying a representation of Venus, of very fine workmanship, the dress of the Goddess hangs in rich and graceful folds. A carnelian of the third period is in the Royal Collection of Vienna, and represents Helena." Of course, there are very many other fine specimens, the value of stone cameos being well known to all collectors of articles of virtu.

No, my little girl is right, flints are not carnelians; but these carnelians and agates found so plentifully upon the Norfolk sea-beaches (having been washed out of the boulder clay and glacial drift in which they were brought from the igneous rocks far to the north) are the true chalcedony, certainly of the ancients, if not of all modern writers.

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II.

ACULEATE-HYMENOPTERA AT TOSTOCK, NEAR BURY ST. EDMUND'S.

By W. H. Tuck.

Read 31st October, 1899.

The fine dry season of 1899 was an unusually brilliant one for field work, and although I was unable to get out before the end of May I added the following to my list of Aculeate-Hymenoptera :—

Formica fusca, Linn. I found a small colony on the heath in July, and again in September on Bungay Common.

Lasius alienus, Först. I took several workers upon the heath in July under stones. I believe this species is generally overlooked, as it only is a little *paler* than *Lasius niger*.

Mutilla rufipes, Ltr. July 8th, two males in bright sunshine on a sandy bank.

Pompilus rufipes, Linn. August 27th, a female on a sandy bank.

Diodontus tristis, V. de Lind. July 11th, a female on Cow Parsley.

Cerceris ornata, Fab. August 27th, several on a sandy bank.

Sphecodes longulus, V. Hag. May 28th, on ground which I have worked often before. A female in company with other common species. This is a new record for Suffolk.

Dasypoda hirtipes, Latr. July 9th, a fine male, highly coloured, on Dutch Clover.

Anthophora retusa, Linn. I took a female of this rare Bee on the White Nettle, June 1st.

My list, therefore, now stands :—Ants 12, Fossores 62, Wasps 13, Bees 122 : total 209 ; and compares favourably with our county list of 282 species, which includes all Kirby's captures.

On May 28th I took a male Sphecodes, which Mr. E. Saunders and Mr. F. Sladen both agree is S. similis, and no doubt

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a hybernated specimen, as the males of this Bee do not, with the exception of *S. rubicundus*, appear until autumn. Neither Crabros nor Wasps were at all conspicuous this season.

On July 18th I took a fine specimen of Sesia ichneuminiformis (the six-banded Clearwing) on a flower just outside Norton Wood, a very unusual locality for it to occur.

The brilliant weather tempted me to make several excursions, one to Mousehold Heath, which is a grand hunting-ground. Here I took the rare Hemipteron, Nabis boops and the curious Aphanus pedestris.

At Southwold, on the common, I found the rare and large Ichneumon vespoides, also many males of a Saw-fly, Athalia spinarum, which, under the name of the "black jack," caused the loss of thousands of acres of turnips, especially round Lowestoft, in 1859.

At Bungay I took another good Saw-fly, Macrophya rustica, and at Tostock, Tenthredopsis flavomaculata and T. nigricollis.

At Aldeburgh I noticed the large pentatomid Piezodorus lituratus on Furze and Tamarisk, and the pretty capsid Calocoris infusus on Oaks.

On the sands, near Thorpe, I took a rare Dipteron, Actora æstuum sitting on a dead crab. This is new to our Suffolk list. Other good and striking Flies I had there were Pyrophæma ocymi and Baleoptera 3-punctata, while in the general list, during the season, I can record Stratiomys potamida, Criorrhyna oxyacanthæ, Conops 4-fasciatus, Calliphora erythrocephala, and Eristalis æneus. Among Coleoptera the family of Coccinella were unusually abundant, the best being Micraspis 12-punctata (Bungay), Coccinella 19-punctata (Aldeburgh), Halyzia 16-guttata, and Chilocorus bipustulatus. Prionus coriarius again turned up in old timber, and also Saperda carcharias, which, flying in the bright sunshine, might be well mistaken for a "locust," under which name it is known to the country folks in East Anglia.

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III.

PRECIOUS STONES.

By J. T. Hotblack.

Read 28th November, 1899.

My inquiry as to what are precious stones commenced when I was very young, with an inquiry of my father on the beach at Yarmouth as to what was a carnelian.

In following that inquiry up (and I hope some day when my leisure and industry are sufficient for the preparation of the paper to say something to this Society upon the question, what is a carnelian? but that paper would take some little preparation, as I should have to state at length my objections to the way in which chalcedony is confounded with flint by most of the authorities who have written on this subject) I have for many years from time to time collected facts about precious stones in general. The time at my disposal this evening will allow of but a very elementary treatment of the subject, and leaving carnelian and the whole great family of chalcedony and quartz crystal, which are all so closely allied, and which may be rightly considered as being the most plentiful and least valuable of all the precious stones, I shall proceed to the other end of the list, and begin at the top of the tree with the most valuable and incomparable diamond.

Diamond.

The diamond is at once the hardest and most beautiful substance known, and is peculiar among all the precious stones, as being the only one that is always called by its right name.

All other stones are called by different names, according to their colour, as will be explained more fully presently, but the diamond, be it white, yellow, red, blue, green, black, or any other colour, is

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always called rightly a diamond. The off colour or yellowish stones are the least valuable, and, generally speaking, the whiter a stone the more its value, an average quality white stone of one carat weight, such a one as shown about the size of a small pea, would be worth about ten pounds, perhaps more at the present time, and the price always of course varying very much, according to the purity and brilliancy of the specimen. But some of the colours were extremely rare, and fetched at times very fancy prices. I have heard lately of a red stone of one carat being valued at £100, and that a blue of the same weight could hardly be found to match it even if £1,000 were forthcoming to pay for it. I have a record of. a green stone, but just over one carat, being sold for £300.

Diamonds and their value have been known in the East from time immemorial, but it is only comparatively recently that the art of cutting and polishing has been discovered. Anciently both in the East and West they were all worn uncut and unpolished. The right recognition of their great superiority to all other stones is also quite recent. In ancient times stones which would now not be reckoned as of a hundredth part the same value as a diamond the same size, were by the ancients considered almost if not quite as valuable. Until comparatively recent times all diamonds came from the East. When they were first discovered in Brazil, it was said the stones brought from there were only the refuse of the Indian mines sent there and brought back again. Now we recognise fine Brazilian stones as the very best, and dealers are fond of dilating on the inferiority of those from the Cape, but there have been many fine stones brought from the Cape. Still, there is something in the whiteness of a Cape stone easily recognised by almost any dealer, and which I must confess does not please me so well as the limpid light of what is called fine old Brazilian stuff.

At and near Kimberley are what perhaps may be properly called the only diamond mines in the world—all other workings for diamonds which I have ever heard of have been nothing but alluvial washings, or the findings of stones which have by some agency been dispersed sparsely over a considerable area—but at Kimberley we have mines where in a comparatively very small space diamonds are as thick in the ground as they well can be.

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We are fortunate in having on the table several specimens of the celebrated "blue ground" from the Kimberley mine, some belonging to the Museum, which were brought from the mine by Mr. Hackblock, one specimen of which shows a fair-sized diamond *in situ*, and which has the seal and a numbered mark of the De Beers Company, to show that it has been given by them. The other specimens of blue ground belong to myself, and were brought by me from the Company's show at the Antwerp Exhibition, where they were showing the process of washing, and there is also on the table some of the gravel left after the washing, and from which most of the diamonds are picked. There are also found in the gravel very many garnets, in fact garnets seem always to be found in plenty with all sorts of other more precious stones. In this gravel, from which all the marketable stones have been taken, many small garnets may still be seen, and very small sparks of diamond may also be recognised. Perhaps I may here emphasise the fact, for I think there is no doubt that it is a fact, that even in this De Beers mine the diamonds are not in their true matrix. There is, I think, abundant proof of this in the many stones found already broken and in the worn appearance of nearly all. I take it that the blue ground is a kind of volcanic mud with which, or into which, the diamond has been thrown out of some airtight furnace of almost inconceivable heat, where the carbon has been crystallised far down in the bowels of the earth. I could say much more about this wonderful stone, but the time at my disposal compels me to proceed, that I may give even a short account of some of the other "gem" stones.

Corundum.

The next I shall mention may very well be taken as an example of almost all the rest, as it is after the diamond more valuable and important than perhaps all the others. It is the stone generally called a ruby or a sapphire, according to its colour, but the proper name of which is corundum. It is one degree less hard than the diamond, which is reckoned ten, the corundum being nine in the recognised scale, the composition and specific gravity of the two stones also being very different. The S.G. of corundum is 3.9 to 4.1 or 4.2. Its composition is about alumina 93.0, lime 1.0,

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water 3.0. The S.G of diamond being 3.4 to 3.6 and its composition pure carbon.

This stone, when green, is the Oriental emerald, one of the rarest and most beautiful of all gems. Emanuel says in his work on precious stones: "I have only met with one specimen."

When yellow the Oriental topaz. Oriental amethyst, aquamarine, hyacinth, peridot, chrysolite, &c., are all corundums, the colour of the gems after which they are called, but to which they are very superior.

White and yellow corundums are constantly being sold as diamonds. The King of Portugal, I think, is said to have the largest diamond in the world, if it is not a white sapphire. The ruby should be the colour of pigeon's blood, when it is much more valuable than the finest white diamond.

From the earliest middle ages a ring set with a sapphire and worn on the fore-finger has been the symbol of investiture with the office of bishop, by reason of its violet colour agreeing with the Episcopal vestments. See King's antique gems. These rings are well known to most antiquarians, there are several in the Fitch Collection in the Museum, and I have one found locally not long since.

As the diamond is pure carbon, so the corundum is nearly pure alumina.

Chrysoberyl.

The three following stones decrease in hardness in proportion as they have less alumina in their composition; the hardest of them, and the next hardest to corundum, is the chrysoberyl, it has about 80.0 of alumina, and almost all the rest glucina, and is reckoned 8.5 in the scale of hardness, and the S.G. 3.4 to 3.8. This stone is of comparatively little value, except when opalescent as a cat's eye, when it is called a chrysoberyl cat's eye, or if milky opalescent a cymophane cat's eye, both of which are very valuable, epecially if the rays are brilliant. Yet the white chrysoberyl, when cut as a brilliant, has considerable lustre, and is easily mistaken for a diamond. The yellow, greenish yellow, brownish yellow, and reddish brown are called chrysolite, the reddish green is Alexandrite. The refraction of this stone is double in a high degree, which makes it very difficult to cut properly, and this is, I think, the reason for its little use.

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Spinel.

The next of the alumina stones is the spinel, which has about 70.0 of alumina, and nearly all the rest magnesia, it is reckoned eight in the scale of hardness; its S.G. 3.5 to 4.8. This stone is called by its proper name when white, blue, green, or dark red, but when a lighter red it is the balas ruby, and this is the form in which it is usually met with; in fact, most of the rubies which I have seen in jewellery have been only balas rubies, their lustre is very inferior to that of the true ruby.

Topaz.

The next and last of the stones, with more alumina than anything else in their composition, is the topaz, it has from 50.0 to 60.0 of alumina, 25.0 to 35.0 silica, and about 15.0 florine. This is the first stone, reckoning down from the diamond, with any considerable proportion of silica in its composition, it is reckoned eight, or nearly eight, in the scale of hardness; its S.G. is 3.4 to 3.6. This stone is called by its proper name when white, yellow, pink, orange, cinnamon, or blue, when sea-green it is an aqua marine, when light blue it is called Brazilian sapphire, when greenish yellow Brazilian chrysolite, when pinky red Brazilian ruby, but in the latter cases has frequently been artificially coloured. The topaz is of very small value as a jewel; still, I believe that most of the stones sold as topaz, even when of the true topaz colour, *i.e.*, pale yellow, are only yellow quartz, and a great deal of aqua marine is but sea-green quartz.

Emerald or Beryl.

Perhaps the next in hardness is the emerald or beryl, as it is variously called, according to its colour; it is reckoned 7.5 to 8.0 in the scale of hardness, its S.G. is 2.65 to 2.75, and its composition is about 68.0 silica, 16 alumina, and 14 glucina or berylla. This stone, when a fine green colour, is the true emerald, though not so valuable as the "Oriental" or corundum emerald, when pale sea-green it is an aqua marine, and when white, blue, yellow, or pink is called beryl. It is sometimes found in crystals of immense size. There was one from America at the 1851 Exhibition weighing 78 lbs., and there has been one reported as found in

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America, *i.e.*, in the States, weighing five tons, and still said to be crystal, and not amorphous. When white, or indeed of any common colour, it is often mistaken for quartz crystal; but the crystals are seldom perfect, or of a uniform colour, and so good emeralds, even of a moderate size, are of considerable value, for the same reason this stone is almost always cut table-topped.

Zircon.

The stone I propose to put next is properly called zircon, but more generally according to its colour, hyacinth or jacinth; it is 7.5 in the scale of hardness, its S.G. 4.0 to 4.75, and its composition is about 65.0 zircon and 33.0 silica. The various shades of red, including orange red and poppy red, are called hyacinth; brownish yellow, reddish brown, and cinnamon are jacinth; if green, yellow, brown, white, and grey it is called jargoon, and sometimes the white stones are called Matura diamonds.

This stone is seldom used in jewellery in its own name, but is frequently sold as diamond, it being more like a diamond in lustre than any other substitute; not long since jargoon was supposed to be inferior diamond. It is found in very many places, including Vesuvius, *in ejected* blocks, the Island of Harris in the Hebrides, and in Ireland, but, perhaps, in greatest abundance in Matura in Ceylon, and is called by the natives Matura diamond, except to the uninitiated when the Matura is omitted. It is seldom found of a larger size than 10 carats. Its value in the rough is nominal and I can only wonder that a stone with so much beauty is not more used than it is.

Zircons, in every way identical with the zircons of nature, are said to have been produced artificially to M. Henri Deville by passing fluoride of silicum over zircon at a red heat. He, therefore, believes that zircon has been formed by igneous agency.

Tourmaline.

The next stone I shall treat of is the tourmaline, from 7.0 to 7.5 in the scale of hardness. The composition varies considerably, but there is always nearly 40.0 of silica, from 30.0 to 40.0 of alumina, and from 5.0 to 8.0 of boracic acid; in addition there is sometimes about 14.0 of magnesia, but in specimens from Siberia there is no magnesia; and in the green from Brazil, there is about 6.0 of

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protoxide of iron, with no magnesia. This stone is hardly ever sold under its proper name, but the green is sold as emerald, the red, brown, and black as ruby, the blue, yellow, and white as sapphire, and the greenish blue are the French *Saphir du Bresil.*

This stone, in consequence of its general dulness and want of lustre, has to be cut thin and set with a proper foil. Though classed among the least valuable of the precious stones in Europe, in Brazil it is highly valued, and is there worn by the Bishops, &c., in place of the true sapphire.

The green also is principally from Brazil, and is called Brazilian emerald. Red tourmaline or rubellite is valuable when free from flaws; the finest known specimen of it is, or was, in Case 40, Room III., British Museum, it came from the King of Ava, and has been valued at £1,000.

The tourmaline is principally interesting on account of its very peculiar physical properties.

The crystals are generally differently terminated, which is an exception to the general law of crystallization, and, in consequence, a crystal may be so heated as to be positively electric at one end and negative at the other. The state of polarity may be reversed by great cold—cut in slices, it is used in the polariscope to analyse the optical properties of other minerals. Two slices cut parallel with their axis, and laid one on the other in the same direction, are transparent, but if laid in reverse directions they become opaque. If a double refracting crystal is placed between two slices of tourmaline, the part covered by the crystal is transparent, while the rest is opaque. The transparent varieties are generally trap-cut, the opaque are faceted both above and below the girdle.

The lapidary has to remember that this stone is only transparent in one direction, and that unless the table is parallel with the axis of crystallization an otherwise transparent stone will appear opaque in trying to look through it. The specific gravity of tourmaline is about 3.0 to 3.3.

Iolite.

Closely allied to tourmaline is iolite, with a hardness of 7 to 7.5, and a composition of about silica 48, alumina 31, magnesia 10, protoxide of iron 8, but its specific gravity is only 2.6 about. Iolite is found in Ireland, Spain, Greenland, and other countries; it is not much employed in jewellery. The transparent variety found

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in Ceylon is the sapphire d'eau, it is white with celestial blue, a sort of mixed colour when looked at in different directions, a peculiarity due to its dichroism.

Garnet.

This is, perhaps, the most abundant and most largely used of all the "precious" stones, and is consequently of but small value. It varies very much, ranging in hardness from 6.5 to 7.5, in S.G. from 3.0 to 4.3, and I have notes of the following composition :—

Alumina	19.35	28.50	20.50	21.20
Silica	38.25	40.00	36.30	31.80
Lime	31.75	3.50	—	37.20
Oxide of Iron ...	7.33	16.50	43.20	6.00
Magnesia ...	2.40	10.00	—	3.00

It is, as a rule, only called garnet by jewellers when dark red ; when bright red it is called by them almandine ; when vermilion it is called pyrope ; when white, yellow, or orange it is called cinnamon stone ; when red and cut *en carbochon*, or tallow-topped, it is the carbuncle, but most jewellers, at all events in the provinces, seem not to know this.

Garnets are also found in brown, green, black, and in fact of any and every colour, but these are very little used in jewellery. This stone is found in its different varieties almost everywhere in the igneous rocks, and among other pebbles derived from the igneous rocks, it is found with almost all the other precious stones, very many in the Diamond Mines at Kimberley.

The Chrysolite

has a hardness of 6.0 to 7.0, S.G. of 3.3 to 3.5, and I find its composition stated as silica 39.73, magnesia 50.13, proto-oxide of iron 9.19.

This is the true chrysolite, though the jewellers generally call the chrysoberyl by that name.

When yellow, red, brown, or light green it should be called chrysolite, when dark olive green it is the peridot, and when yellowish green it is called olivine. This stone is met with in many places in substance of volcanic origin, it has been found in the lava of Vesuvius, and is like all the harder crystals, no doubt,

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of igneous origin, but is the softest, or one of the softest, crystals used in jewellery, being easily scratched, and for that reason it is in small demand in this country, though sometimes of a beautiful deep colour, it is generally cut in steps, sometimes *en cabochon*, but on the Continent it is often cut like a rose diamond, and set with a good foil.

The value is so small that good specimens may now be bought at 1s. to 10s. a carat, though a few years since they were worth much more.

Kyanite.

The next stone I propose to treat of is variously called kyanit, kyanite, and sappare; its hardness is 5, and in the lateral planes 7, the S.G. is 3.55 to 3.60, and Bristow gives the composition variously as:

Silica	34.33	62.38
Alumina	64.89	37.62

It will be noticed how the proportions are reversed.

It occurs both crystallized and massive, generally in gneiss or mica slate. The colour is generally pale blue, but also white, grey, greenish, and black.

Sappare is the name given by French jewellers to this stone when brought ready cut and polished from India, where it has probably been sold as true sapphire.

Though not held in much esteem, some specimens, by reason of their fine colour and play of light, may easily be mistaken for real sapphire, for which no doubt they are generally sold.

The stones which I have enumerated so far, I believe all to be of igneous origin, and by that I mean that they have cooled and crystallized far down in the bowels of the earth, and that when found in volcanic lava as garnets, chrysolites, and others sometimes are, they have been thrown there, and were not formed there.

Idocrase.

The stone I propose to treat of next, the idocrase, I cannot claim to have always so high or rather low an origin, as among other places it seems to be found at Vesuvius, in crystals of brown and green "lining the cavities of volcanic rocks." It also occurs massive. The stone has a hardness of 6.5, S.G. 3.35 to 3.50, and I find its composition stated as: Silica 37.50, alumina 18.50, lime 33.70,

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protoxide of iron 6.25. The colours are brown, green, yellow, sometimes blue and black. It is sold as chrysolite or hyacinth, according to colour. It is too soft to be of any value, but is cut into jewels and ornaments principally at Naples and Turin.

Felspar, or Feldspar.

This substance is never sold in jewellery under this name, it is found in tabular crystals and in cleavable masses, the best is no more than 6 in the scale of hardness, and the S.G. is 2.4 to 2.6. Its composition is about: Silica 64.0, alumina 19.5, potash 15.0. When pearly white and chatoyant it is the moon stone, when opalescent it is called Ceylon opal or water opal, when pale yellow with minute golden spangles it is sun stone, when opaque green (from trace of copper in composition) it is the Amazon stone. At one time the moon stone was fashionable in this country, but is now seldom seen. The moon stone was also much esteemed by the ancients.

Labradorite, or Labrador Felspar

has a hardness of 6, S.G. 2.65 to 2.75, and its composition is about: Silica 55.0, alumina 27.0, lime 11.0, soda 5.0. When vitreous and pearly, greenish to white, is chatoyant; it is called by jewellers by its true name labradorite. It is found in Scotland and Ireland, as well as in many foreign countries. Though not much used in jewellery, it is manufactured into brooches, bracelets, &c., but a great deal of skill is necessary to divide the stone so that the iridescence, on which its beauty depends, is displayed to the best advantage.

Lapis Lazuli

is found sometimes in small crystal, but generally massive, and is I think, the softest of the crystals used in jewellery, being only 5.0 in hardness, and about 2.35 to 2.45 in S.G. Its composition is variable. I find:

Silica	46.0	45.5
Alumina	14.5	37.5
Lime	17.5	3.5
Carbonic Acid	10.0	—
Sulphuric Acid	4.0	3.5
Protoxide of Iron	3.0	—
Soda	—	9.0

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The lapis lazuli of jewellers should be an opaque but rich azure-blue. It is not infrequently found with iron pyrites disseminated through it, when it has the appearance of being spotted with gold.

This stone was well known to the ancients, and is still extensively used for studs, pins, and other articles of jewellery, but it is most used for vases, mosaic work, and to ornament furniture. Many fine examples exist in Continental Catholic Churches in pillars and adornments of the altars, shrines, &c.

This stone, when ground to powder, is the true ultramarine once so valuable, but now nearly superseded by a manufactured substitute at not a hundredth part of the cost.

Jade or Nephrite.

This stone is, I think, never found crystallized. Its composition is very variable, so much so that it is not classed as a distinct mineral. Its hardness ranges from 6 to 7, its S.G. from 2.9 to 3.1, and I find its composition variously stated as under:

Silica	50.5	58.9
Magnesia	31.0	22.4
Lime	—	12.3
Alumina	10.0	1.3
Protoxide of Iron	5.5	2.7
Water	2.8	0.3

Though seldom used for purposes of jewellery in this country, through the whole of Asia jade is very highly esteemed. The colour most valued is a pale greenish grey, and good specimens fetch very large prices.

Jade is found in China, Egypt, Corsia, and in other places in the old world, and in Australia and New Zealand; the natives of the latter, and other islands, used it for the heads of axes and other weapons, grinding it to a sharp cutting edge with a fine polish. This New Zealand jade was said at one time not to be the same as the stone so highly valued by the Chinese mandarins for their buttons of high office, but I think it is now admitted that the one cannot be distinguished from the other.

Turquoise.

This is another stone never found crystallized, but while jade is sometimes found in rather large masses, turquoise is, I think,

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never found except in very small pieces. It is also the softest of all the gem stones, being 6 only in hardness, with a S.G. of 2.6 to 3.0. I have notes of the following compositions:—

	Silesia.	Persia.	
Alumina	44.50	47.45	46.90
Phosphoric Acid ...	30.90	27.35	32.60
Water	19.00	18.20	20.50
Protoxide of Copper ...	3.75	2.00	—
Phosphate of Lime ...	—	3.40	—

It is found white and green, and probably in other colours besides the orthodox turquoise blue. Stones of this last colour are the only ones that have any commercial value, and they come almost entirely from Persia. Good stones large enough to set in single stone rings are readily worth from £10 to £40 each, and larger stones of a good colour are so extremely rare that they fetch almost fabulous prices. Turquoise are always cut *en cabochon*. Turquoise are found in groups of small nodules in sandstone, also in veins about a tenth of an inch in thickness, crossways of the bedding of the sandstone.

There is a fossil bone, "odontolite," of turquoise colour, which is sometimes sold for the true stone, but it is generally of an inky blue colour, which is never seen in the real turquoise, and its texture often shows traces of its organic origin. Many artificial turquoise are made, and very successfully for colour, but they may be easily distinguished from the real stone by its greater lustre and better gloss.

Having finished (with the exception of the quartz family which I propose to treat separately and last) all the stones generally used in jewellery, I think it necessary to treat of three out of the four other principal substances used for jewellery. The one I shall not treat of is the pearl, because being a substance of present animal growth it has no interest to the mineralogist.

Malachite

is really a metal, being a form of copper ore. Its hardness is but 3.5, its S.G. 3.7 to 4.0, and I find its composition stated as under:

Protoxide of Copper	70.5	72.2
Carbonic Acid	18.0	18.5
Water	11.5	9.3

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Malachite is found in many places in Europe and Asia, and also in Australia; it would probably also be present in both Africa and America. Most of it is melted for the large quantity of copper which it contains, only a small portion being fit for ornamental purposes, and the best and most compact variety susceptible of a high polish is very rare; the best comes from Siberia. In Russia even the doors of palaces have been made of it, but it is mostly used for cabinet work. Though some is used in jewellery, it is not of much value.

Amber

is a fossilized gum, its hardness is but 2.0 to 2.5, its S.G. 1.08, its composition: Carbon 79.0 to 81.0; hydrogen 7.30 to 10.50; oxygen 6.70 to 10.50.

It varies from nearly, or quite transparent, to quite opaque. It burns readily, giving an agreeable odour. The colour varies from nearly white to a deep yellow or brownish orange. It is very brittle, and can be cut with a knife.

Amber is, perhaps, most interesting to 'Naturalists' on account of the number of insects found imbedded in it. I have seen 163 species of insects enumerated as found in amber, most of which would have been unknown to science but for their presence there. Amber principally comes from the coasts of the Baltic, though some of the finest quality is dredged in the North Sea by English fishing-boats, and finds a ready sale at a good price to dealers who understand its value at all the fishing ports. The opaque and less valuable is called by the dealers "fat amber," and there is some petrified gum brought from Australia, which it is hard to distinguish from it.

There is a tradition at Yarmouth and Lowestoft that some time since a lot of this Australian gum, which I believe is largely sent to this country for the making of varnish, was wrecked off there. I have myself a specimen dredged in the North Sea, which some "experts" declare to be this Australian gum; but others, including a dealer who says that before he came to England to live he was a dealer in amber in Prussia, where there are considerable quantities mined for inland, in addition to that found on the coast of the Baltic. He said, "That's fat amber; do you think I don't know! Why, when I came to England, more than 40 years ago, 'Amber

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Merchant' was on my passport." I have also found it, as have others, in the "forest-bed." Amber is not much esteemed for jewellery in this country, but in Turkey and neighbouring Asia it is a good deal thought of.

Jet

is really a variety of coal, with a hardness of only 1.5, and a S.G. of 1.3. It is much blacker, tougher, and harder than ordinary cannel coal, and is capable of taking a very bright polish. It was at one time much used in England for mourning jewellery. It is found in detached pieces in clay at Whitby and other places in Yorkshire, also on the Baltic Coast, in the Ardennes, and the Pyrenees, but some of the very best is dredged by the fishing-boats in the North Sea, and sold at the fishing ports to the same dealers as buy the amber, but at a much lower price. Jet is still much esteemed in Spain, and also in Turkey. Jet is but slightly heavier than water; it burns readily, and emits a strong, sweet bituminous smell.

Rock Crystal.

This, with the uncrystallized forms of the same material (*i.e.*, silica), is so important, that instead of putting them in their proper places, according to their hardness, I have preferred to treat of them last of all, for as the diamond, which is pure carbon, heads the list of stones, so I think rock crystal, chalcedony, and opal, the first of which is practically pure, and the others almost pure silica, may very properly end the list of precious stones, both by reason of their great abundance and their very general use.

Rock crystal is about 7 in the scale of hardness, its S.G. is 2.6, and it is practically pure silica. It is very largely used in jewellery under various names. When white it is sometimes called by its proper name, at others it is Cornish or Bristol diamond, when violet it is the true amethyst, when yellow or brown the cairngorm, when red rose quartz, and I more than suspect that most of the topaz is but pale yellow rock crystal. Jewellers, when they wish to be precise, call it false topaz, and much aquamarine is but the same stone, sea-green. Unfortunately rock crystal can be easily artificially coloured. At one time Cornish diamonds were highly esteemed, and some finely-cut examples are still to be met with in

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the old jewellery of local families. It is said that good stones are now seldom found.

The amethyst also was once much more valuable than now. I have seen it stated that so recently as 1867 a good coloured amethyst, of the size of a 2s. piece, was worth £10 or £15, and that in 1652 an amethyst was worth as much as a diamond of the same size.

Now, rock crystals of all colours have been found in Brazil in such immense quantities that they have very much sunk in value, and it is even said that many of the Scotch cairngorms are really Brazilian stones.

Chalcedony

is the same material as rock crystal, but not crystallized, and slightly less pure. Its hardness and S.G. are almost exactly the same. When dark red it is sard, when lighter red it is carnelian, when yellow to white it is carnelian, when striped it is agate, when black or dark brown with white layers it is onyx, when red or light brown with white layers it is sardonyx, when chatoyant it is a cat's-eye.

This is the stone in which the beautiful cameos of the ancients were almost exclusively carved, and it is still used for that recently revived art. It has been esteemed from the earliest times as superior to all other stones for the engraving of seals, and it is still almost, if not quite exclusively, used for that purpose. It is also used to-day in enormous quantities for all sorts of cheap jewellery.

Jasper, which may be any colour, and bloodstone, which should be green with red spots, are closely allied to chalcedony, but are slightly less pure. The latter is used principally for ring-stones, the former, more for decorative cabinet-making and building purposes than for jewellery.

Opal.

Another uncrystallized form of silica is, perhaps, nearer to rock crystal than chalcedony, being almost pure silica with a little water, varying from 6 to 10 per cent., but the hardness is less from 5.5 to 6.5, and the S.G. 2.0 to 2.3. Every one knows this beautiful gem. When in perfection it is the noble or precious opal, and is very

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valuable, as is also the reddish or fire opal; when less perfect it is the semi or common opal. The noble or precious opal is one of the most beautiful gems in existence. The "opalescence" is due to the presence of the water in the silica. Opals are always cut *en cabochon* on both sides, they are very brittle. Opals are much more brilliant when in a warm atmosphere, and dealers, knowing this, are in the habit of holding them in the hand before showing. Fine stones of large size are very rare, they seldom exceed an inch in diameter. For large fine specimens as much as £1,000 has been frequently paid. The finest known is in the Museum at Vienna, it came from the celebrated mines at Carnowitza, which have been worked since 1400; it is $4\frac{3}{4}$ ins. by $2\frac{1}{2}$ ins., weighs 17 ozs., and has been valued at £70,000.

The hydrophane or Mexican opal quite loses its beauty if allowed to get damp or wet, and Sir Walter Scott, knowing this fact, makes use of it in 'Anne of Geierstein,' after the publication of which, the belief that opals were unlucky became so general that they went very much out of fashion. The original splendour can, however, be quite restored by the application of a little heat. Of late years opals have been again coming in fashion, and they should be very highly esteemed, not only for their natural beauty, but also because they are, perhaps, the only precious stones which cannot be imitated.

Wood-opal.

Having described amber and jet, I think it right to include wood-opal, which is also of organic origin, and but very distantly related to true opal. Wood-opal is silicified wood, or wood petrified by silica, and it generally retains the structure of the original wood. It is found in many places, but, perhaps, most abundantly in the desert between Cairo and Suez, where silicified trunks of trees belonging to the *Nicolia ægyptiaca* sometimes 40 or 50 feet long, and one or two feet in diameter, are found lying in all directions. Wood-opal has considerable beauty, and is used for several artistic and ornamental purposes.

Obsidian.

Obsidian is a volcanic glass found in many lavas; it has

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a hardness of 6.5 to 7.0, and a S.G. of 2.25 to 2.75. Its composition is variously stated :

Silica	84.0	83.0	69.5
Protoxide of Iron	5.0	6.0	2.5
Alumina	4.6	3.0	2.6
Soda	3.5	5.5	5.0
Lime	2.4	2.5	7.5
Potash	—	—	7.0
Magnesia	—	—	2.6

It is never crystallized, is generally of a dark colour, and almost opaque. It is sometimes used for cheap jewellery.

Paste or Strass.

I have some hesitation in including this substance in a description of precious stones. Paste should be a specially fine kind of glass manufactured expressly for artificial gems.

Stras should be a particular kind of paste, so named after its inventor, Joseph Strasser, a German. But I have seen Strass or Stras described as a volcanic rock from the Rhine, much used in the making of artificial gems, and I have reason to suspect, both from information derived from those connected with the trade, and also from the examination of specimens of so-called paste, that much of it is really an impure form of rock crystal, perhaps the same or a similar stone to that described by Thompson, under the name of Kilpatrick quartz, which he thinks entitled to rank as a separate species, with a hardness of 7, a S.G. of 2.5, and a composition of silica 96.0, water 3.0. This is a hardness unattainable, I believe, in glass, and agrees with specimens of "paste" with which I have met.

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IV.

MY CITY GARDEN IN A "CITY OF GARDENS."

By Sir Peter Eade, M.D.

Read 30th January, 1900.

Norwich has long been known by the designation of a "City of Gardens." How long I know not, but we do know that Evelyn, on his visit to Norwich in 1671, spoke of the "flower gardens, in which all the inhabitants excel." He also wrote in his diary that at this visit he went to see Sir Thomas Browne, whose "whole house and garden was a paradise and cabinet of rarities." This garden, I believe, at that time extended from his house in the Market Place (where the late Savings Bank stood) to at least as far as the present Orford Hill, but no portion of it now remains.

It is much to be regretted that so many of the old Norwich gardens have fallen a prey to the requirements or encroachments of the builder; and that where ample space and air for flowers and shrubs, and even trees, formerly existed, there is now nothing but manufactories or houses with small back premises, or at the most, little gardens so surrounded by walls as to be little more than wells, with stagnant air and frequent showers of chimney blacks. Still, in spite of the rapid increase of the city and the gradual absorption of building spaces, we are glad to know that—even in the central parts of the city—some of the old gardens do yet remain, and that they are still able to produce much floral beauty, and in many other ways to contribute to the interest and pleasure of those who are fortunate enough to possess them.

Of course, my present reference is only to gardens situated in the older parts of Norwich. Those who live in our suburbs will doubtless be able to cultivate and utilise their present gardens as the citizens of Norwich did theirs in the "good old times."

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I am glad to say that I (in common with others dwelling in St. Giles's Street and on St. Giles's Plain) am still one of the residents in older Norwich with a garden of considerable size. And in my case this advantage is considerably enhanced by the immediate proximity of Chapel Field. For this large open space of seven acres not only provides a great circulation of air, and so a more healthy vegetation, but also—by its numerous and lofty trees—invites a large amount of varied and varying bird-life.

As I have now been a dweller in St. Giles's for many years, it has occurred to me that a few current notes—however imperfect and superficial—on the capabilities and possibilities of such a central city garden, as illustrated by these, might possibly be an acceptable contribution to the proceedings of this our Norwich 'Naturalists' Society.'

The real object of the paper is to show in a simple way what a large field these home city gardens, according to their size, may still afford for observation and intelligent amusement; and how even in the limited space and depreciated air which naturally belong to many of them, they yet afford great opportunities for the observation of both vegetable and animal life. The simple grass-plots themselves, however small, when carefully tended and shaven, are in themselves a constant source of pleasurable satisfaction; whilst the very worms which inhabit them, and the birds which feed on these, afford much room for study of some of nature's methods and instinctive tendencies.

Doubtless the larger space which I possess gives wider opportunities than smaller gardens. But these must be small indeed which do not offer full repayment for observation of the varied life which exists within them, or which may be imported into them.

My garden is about 60 yards in length, by about 26 yards in width. It runs nearly north and south. It has walls of varying height on its several sides. Near to the house these are covered on one side by trained wasteria and white and yellow jessamine, but the greater part of the other portions is covered with ivy. The area of the ground is principally laid with grass, with a broad gravel walk around it.

Under the east wall is a long terraced rockery, well covered with suitable plants; and along the west wall runs a broader bed devoted to very small shrubs and to flowers. The south end, under a stable

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wall, contains some very ancient and still productive apple trees also two or three beech trees, and an old pink May-tree, under the shade of which some of the commoner ferns flourish abundantly.

A vinery, and a verandah utilised as a summer conservatory, complete this note of the arrangements of my city garden, and from this brief record it will be seen that an effort has been made to make every use of the available space and of its several possibilities.

I do not propose to detain you with any detailed account of the flowers and plants which can be grown, or which flourish fairly at the present date in this limited city garden. There are many which are hopeless by reason of the city air and city soil. And I have found the more delicate flowers to be so uncertain as to be scarcely worth the trouble of planting out. Others again fall inevitable victims to the myriads of autumn slugs. But spring bulbs, the autumn hardy flowers, and some annuals, as well as the robuster ferns, do well, and fully repay the trouble of cultivation.

As to ferns, in my former and more open garden higher up the street, I once had as many as forty different varieties growing abroad; but, of course, these gradually died out, so that at the end of four or five years only the commoner and hardier sorts remained. Some of these, which were removed, are still very fine specimens, and have lasted in their new home, as such, for many years.

It would have been very interesting had any list or catalogue of Sir Thomas Browne's "paradise" of vegetable rarities been left to us, for a comparison of the possibilities of a city garden 200 years ago with those of the present day, but none such is known to exist.

I have mentioned the fact that several old apple trees exist in my garden, possibly as old as the house itself, which is understood to have been built 160 or 170 years ago. And I would just mention here that beyond the roof of my stable buildings, and seen conspicuously from my garden, rises—nay, towers up towards the sky, that grand old Aspen-poplar, which is, perhaps, the greatest ornament of the adjacent Chapel Field, though I think scarcely adequately appreciated. This tree has a girth of some 15 feet about a yard above the ground, is 90 to 100 feet high, and was so remarkable even 58 years ago as to have been then pictured by Grigor, in his 'Eastern Arboretum,' as one of the most notable trees in this district. In its later state a photographic sketch of it

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is given in my book on St. Giles's parish, published in 1886, although I fear that this scarcely adequately pictures its grandeur.

Blomfield states that the great avenue of elm trees in Chapel Field, also partly visible from my garden, was planted in 1746 by Sir Thomas Churchman, who is understood to have then lived in my present house, and who, I believe, then hired the open Chapel Field of the Norwich Corporation. It may be interesting to state here that some three or four years ago one of the largest of that row of elm trees was blown down in a gale. When this tree was sawn across, I took the trouble to count the rings which this section displayed. The outer ones were so thin and irregular that it was not possible to tell their number quite exactly, but as nearly as I could count the total number was between 140 and 150. This number, added to the few which would exist on the young tree when planted, would give a date approximating very closely to that assigned by Blomfield. This is an interesting historical fact, though, perhaps, somewhat irrelevant, and its mention will, I hope, be excused on this ground.

In my own garden the various trees appear to be healthy, but some of them increase very slowly. A small pear tree planted against the ivy-covered wall some twenty years ago is scarcely larger than when planted there, even although it every year sends out a full quantity of fresh green shoots. And a pink thorn tree, transplanted into it a few years ago, actually remained perfectly quiescent, as if dead, for a whole year, and then resumed vitality and growth. It is now a vigorous healthy tree, sending forth every year its normal shoots and blossoms.

Animal Life.—Such a garden as mine affords a considerable opportunity for observing the ways, and habits, and manners of many *animals*, none of which are uninteresting. Shall I weary you by mentioning *the cats*, which so often make it their playground, and their afternoon as well as their nightly meeting-place? Although I cannot say that *caterwauling* is harmonious, or equivalent to the strains of the bands which so agreeably discourse music in the adjacent Chapel Field on summer evenings, yet there is much of interest, as well as amusement, to be derived from noting the varied yet distinct language, and from watching the very curious customs of the cats themselves, familiar as these may be to all of us. I am favoured with visits of cats of all sizes and all colours—black, grey,

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cyprus, sandy, grey and white, and almost all intermediate shades. And it is certainly curious to watch the manifestations of their loves and their hates, their friendliness and their jealousies, their sunny enjoyments and their predatory instincts, and their methods of attack and defence. These latter, though often very noisy, by no means necessarily consist in open fighting, but are very commonly carried on by what Mr. C. Morris calls the "mentality of latter-day life. These hostile cats (as you have probably observed) will very constantly settle their relative superiority, not by biting and scratching, or actual fighting, but by what is actually a 'staring match,' in which the influence of mind over matter is well demonstrated. They place themselves a few feet apart, and stare at each other, until one of them confesses himself beaten, by slowly backing away from his opponent, and then suddenly turning round and running away. This is a form of duelling which might well be copied in human life; and, still more, might properly be adopted in the case of nations, where 'mental' arbitration, from a steady calculation of strength, would take the place of bullets and bayonets.

As with Cats, so with *Sparrows*, it may be said that they are constant friends that are always with us. Yet though so common, they are a never failing source of interest in a city garden, if only because they always provide some conspicuous life and motion; and in mine, because they may nearly always be heard chirping or quarrelling in the ivy, which covers so much of the garden walls.

I am sorry that Miss Ormerod gives them such a bad character as to their appetites. But not being personally engaged in agriculture, I can only rejoice that nature has provided them with such strong constitutions, and healthy and active digestions. Beyond this, it is certainly a pleasure to a townsman to note their chatterings, their amicable, if noisy, contentions for the best places in the ivy, their demonstrative courtships, their dust-baths in the dry ground, or their water-baths in the pans provided for them for this purpose, and their evident love for the neighbourhood and companionship (at a properly-regulated distance) of mankind.

What a contrast there is between the active, fluttering, often noisy *House Sparrow*, and its quiet, retiring, and gentle-mannered neighbour, the *Hedge Sparrow*.

This was well illustrated in the early part of last December, in

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this way: the Hedge Sparrow (or Dunnock or Accentor) does not often visit my garden, but one of these pretty birds did come at this time, and having incautiously entered the open door of my greenhouse, got shut up in it. Next morning, on my entering, it was, of course, somewhat frightened. But instead of violently fluttering about, and dashing itself against the window, as the House Sparrow will do in like circumstances, it very quietly and gently flew away from me, and then at once dropped down behind the brick flue, where it remained quiet and concealed, in spite of my efforts to find it, as I desired to do in order to give it its liberty. The same thing exactly happened on some following mornings; and being fed regularly, it has remained there to the present time.

There are plenty of other birds whose visits and whose peculiarities would provide abundant material for a paper much longer than I can venture now to inflict upon you. But they are all welcome for the sake of the varieties of life and habits they present—as well as for what Tennyson so prettily describes as their "singing and calling."

My grass-plot is the feeding-ground of the greedy and quarrelsome *Starlings*, which will often come for their meal of worms or other food at quite regular hours, usually at ten or eleven o'clock in the morning, and three to four in the afternoon. And occasionally the *Jackdaws*, from our neighbouring church-steeple, where they live and breed, will venture—most carefully and cautiously—to alight on the grass in search of food. Whilst even the Norwich *Rooks* will, when hard pressed in bad weather, occasionally dart down from a tree for crusts of bread or other edible matter obtainable in the garden.

Thrushes and *Blackbirds* are chiefly in evidence during the nesting season; and it is noticeable how tame or rather incautious they appear to become during this period. It would almost seem as if the sitting process produced in them (as has been noted of other birds) a dulness or partial stupor of their intelligence. Whilst after hatching, the urgent and continuous calls of their young ones for food evidently render their desire to satisfy these imperative and destructive of prudence. This very year a full-grown Blackbird ventured along the grass in search of worms almost up to the house verandah, in which, unfortunately, a cat lay basking;

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and, as a matter of course, the bird was instantly pounced upon. She escaped, however, almost by a miracle, but she left nearly the whole of her feathers behind her, and almost in a state of nudity.

It is curious to observe how the Blackbirds and Thrushes will not only provide worm-food for their nestlings, but how they will prepare these worms and make them fit for swallowing down the young throats. They will often, when they have tugged a worm out of the grass, proceed to peck it into small and suitable lengths, and will then carry these, arranged in their mouths in suitable bundles, to the nest.

Blackbirds appear not to gain knowledge by experience, at least in some particulars. I witness almost every year a repetition of what I may term "the tragedy of the Blackbirds." Evidently the same old birds will yearly build a nest in almost the same portion of the ivy on one of the walls, and not more than six or seven feet from the ground. Well, this is all right as long as the old birds are merely sitting and make no noise, so as to attract feline attention. But as soon as the young birds are hatched, and begin to make vocal demonstrations, of course they fall victims to their natural enemies and "bird-fanciers," and the nests and their occupants are ruthlessly dragged out from their positions and destroyed. This occurs year after year. I believe that then the birds will sometimes build again elsewhere. But they certainly return to almost the same locality in the following spring, and their offspring again become victims of the inappropriateness of their selected homes.

Plenty of other birds also come to the garden at various times and seasons, and add to its life and interest, *Robins*, *Bluetits*, *Nuthatches*, *Redwings*, *Missel-thrushes*, and others, but of their behaviour in the winter season, and when habitually fed, I have already discoursed to this Society, so will not further trouble you now with their noticeable peculiarities.

Reptiles.—Perhaps it would scarcely be expected that the *Reptile* race would provide much of interest for a city garden. Yet it may be truly said that this class of creatures has done almost more than any other to provide my garden with material for this.

As this Society will know from my previous communications to its 'Transactions,' I have long kept two Tortoises, and year by

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year noted their habits and most remarkable peculiarities. These have been already fully described in the Society's records, and I can only now add to what I before stated, that they still continue to increase in size and in weight, and at about the same rate of progression as twelve or thirteen years ago. They still gain 1½ to 2 ounces in weight in each summer, and lose about 1 or 1¼ ounce in weight during each winter hybernation. The total result is, that whilst they weighed respectively 2 lbs. 10 ozs. and 2 lbs. 5 ozs. in September, 1886, they weighed in October last 3 lbs. 13 ozs. and 3 lbs. 8 ozs., having thus each gained in weight during this period 1 lb. 3 ozs., or on an average about one ounce and a quarter in each year.

Other reptilians which I have tried to domesticate (for observation) in my garden are TOADS and FROGS. But I am bound to say that I have not been successful in preserving them in any numbers for more than a brief period. Their appearance and disappearance has at times been very mysterious and inexplicable, but on the whole those which I have imported have, as a rule, soon either died or been otherwise disposed of. Is it not probable, I would suggest, that they, or at least the smaller ones, have fallen a prey to Jackdaws, Rooks, or even Starlings?

Of the *Frogs* which I brought home, only one survived the second year. But this one appeared to thrive in a remarkable degree for several years. It would apparently lie dormant for many months, and would then re-appear, lively, fat, and much grown, for a few weeks in the late summer or early autumn; after which he would be no more seen until the following year.

Toads are more interesting than Frogs; and, indeed, in a city garden, by no means produce that feeling of loathing which is popularly supposed to be inherent in them. On the contrary, they quickly become tame, and almost assume the *status* of garden pets. And as a matter of fact, I entirely disagree with Shakespeare, who calls them "ugly and venomous."

At first the Toads which I imported would come out regularly on suitable evenings, and sit or hop about on the damp grass or flower-borders. And they exhibited a most special tendency (as has been observed by others) to come down to the house as if desiring an entrance. Indeed, when the door was open they would not unfrequently walk in. And I have more than once found one

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of them in my study or other room, sitting up in a corner, looking happy and comfortable, and quietly staring at me with its bright eyes, as if I were the real intruder.

The direction of my rooms from the garden is from south to north. I do not know if this was possibly expressive of any migratory instinct.

Like the Frogs, of a number of Toads which I introduced into my garden, only three or four remained in the following year; and soon all disappeared, except one, whose end was peculiar and of dramatic interest. It occurred in this way: A neighbour kept in his adjacent garden some other reptiles, namely, some non-poisonous snakes. One of these seems to have escaped from its cage and got over the dividing wall into my garden, and on one summer morning was discovered by me on my grass-plot, with this Toad (about a half-grown one) in his mouth, which he was trying to kill or swallow. I suppose the Toad was too large or too lively, for the snake was making very serious exertions, and was actively agitating its body in a linear direction. When seen at a distance, it looked like a stout piece of cord or fine rope agitated by the wind, with a movement like that of a carpet when it is flapped and shaken. The Toad had been seized by the hinder part of its back, as shown by the two bleeding punctures afterwards found.

When the snake saw me advancing towards it, it rapidly wriggled or undulated away towards the ivy-covered wall, where it was lost. But it retained its hold of the Toad almost to the last, and until I had got quite close up to it.

This incident is not only interesting, but it also shows that these reptiles must have some instinctive power of knowing of the neighbourhood of comparatively distant prey; for the rockery stones from which it was taken must have been at least thirty to forty yards from its own domicile. Such an instinct would seem to be the equivalent of that well known to be possessed by birds of prey. I regret that this poor Toad did not long survive his fright and bad usage.

My Toads have exhibited the usual tendency of these animals to hide away beneath stones or earth, and in unfrequented corners. When discovered it is curious to watch their half-frightened expression, and their peculiar mode of breathing by their under jaw, which appears at once to increase in rapidity. They do not

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resist much when handled, but it is curious to note how they continue to swell their sides out, until they produce a very prominent rotundity of their body. After the episode of the Snake and my Toad, the idea suggests itself that this is intended to make themselves as large as possible, not from envy of the Ox, as stated in the fable with reference to the Frog, but to make themselves too large a morsel to be swallowed by the lesser of those animals which prey upon them.

These "Toads in holes" would come out from their retreat in dry weather, a few hours *before* rain, after which they would again disappear, often for a long season.

INSECTS.—There are plenty of these in every garden, however small; and Bees, Flies, Beetles, and especially Spiders, would afford a never ending source of interest. The only insects which I have specially watched are ANTS, nests and colonies of which appear and re-appear every summer upon my garden paths, or upon the adjacent portions of the grass-plots.

We all know of the very numerous observers of and writers upon these little creatures, and their works from Huber down to Sir John Lubbock, will be more or less familiar to us all. Their industry, their building powers, their gregarious nature, their division of labour, their apparent working for the common good, their devotion to the young, their colonizing instincts, as well as some of the changes which their insect forms undergo, are all there recorded.

And many of these things are easily to be observed by any one who takes the trouble.

I can only venture here to make one or two brief notes on their proceedings in St. Giles's Street.

Both the small brown and the small black Ants are to be here seen, but they occupy different positions; and not only do not seem to be on neighbourly terms with each other, but fight at once if experimentally placed together.

The brown Ants are the more numerous, and in the summer months display an enormous amount of activity. Doubtless there is a good reason for their incessant movements, but to the ordinary observer these often seem to be purposeless and merely the result of restlessness and excess of energy.

The favourite situation for their little Ant-hills is decidedly along

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the edge of the gravel path, where this abuts upon the grass sward, and it is noticeable that almost the whole of these are placed on the easterly edge of this. From these nests, or centres, very little use is made of the adjacent grass territory, but from nearly all a track is made across the gravel path to its opposite (westerly) side, where either a hole is made into a small fresh home, or a semi-tunnel is made through the grass edging on to and into the earth of the flower-border beyond. There appears to be no attempt to tunnel in the firm gravel path, but the incessant racing backward and forward in the same line very soon (as Sir John Lubbock—now Lord Avebury—has pointed out) makes a well-trodden road, along which they follow each other in rapid succession.

As to their hour of rising in the morning for work, I cannot speak from personal observation. But as Solomon holds them out as an example to those inclined unduly to keep their beds, I conclude that their motto is, "Early to rise." But I can say that the opposite half of this proverb, namely, "Early to bed," does not apply to them, for, at least in the warm weather, they do certainly often work until late at night.

It is very interesting to watch these Ants at work, and to note their activity and energy and strength. An Ant is "but a little creature," but he is certainly able to perform a large amount of physical work. And especially is this seen in the way he builds up those little heaps of earth known as Ant-hills. I have had many of these under observation, and the rapidity with which they re-appear after injury by pressure or a heavy rain-storm is very remarkable, twenty-four hours, or even less, being often sufficient for their complete restoration. They are of varying form, but some are perfectly conical, with a circular hole at the top exactly like that of some Norfolk 'kilns' used for the burning of bricks. Others are irregular, or flattened and spongy, with several holes. But it would seem that the varying shapes are largely due to the special conditions under which they are made.

I have often watched these little creatures at work upon their 'heaps,' and have noted how these are gradually built up of aggregations of single grains of earth or sand, which evidently have been dug out grain by grain from the earth, where the excavation is going on, and are then brought in the Ant's mouth to the surface, and to the top of the rising earth-heap. They are then

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dropped over its edge, and the Carrier Ant at once races back into the hole presumably for a fresh burden. This process is a very remarkable one, and the way the Ant brings his grain of earth in his mouth and drops it over the edge of the rising Ant-hill, irresistibly reminds one of a railway navvy who wheels his barrow full of earth and tilts it over the edge of the embankment upon which he is at work. The number of single grains in even a small Ant-heap must be very large, and must amount to many thousands, or perhaps to hundreds of thousands. What, then, must be the untiring energy of a small Ant colony, which can reproduce such a granular heap in less than twenty-four hours.

It does not always seem clear what the streams of Ants from the parent nest are so constantly occupied in. They may be, to a certain extent, colonizers, but they certainly do not, with me, raise secondary ant-hills to any great extent at the end of their runs. They make holes in the ground there, and possibly they may be engaged in their proverbial custom of securing and storing up food for the winter. To the uninstructed eye these holes look very much like Colonial outposts.

The activity of these Ants entirely ceases with the advent of autumn, and their Ant-hills in my garden entirely disappear until the following season.

As we all know, this instinct of storing up food for winter use has been largely denied, but from Sir John Lubbock's account it certainly exists in some species, though its extent varies greatly. As he says that many of the Ants live through the winter, some food would seem to be required.

Speaking of Ants generically, we all doubtless accept King Solomon's authority upon this point, and we shall not forget that the Roman poet Virgil, writing just before the Christian era, expressed himself to the same effect.

> "Ac veluti ingentem formicæ farris acervum
> Cum populant, hyemis memores, tectoque reponunt."

Cicero's high opinion of these creatures is well-known, and is thus expressed by him:

> "In formica non modo sensus, sed etiam meus, ratio, memoria."

Lastly, did time and inclination permit, I might have found endless interest in observing the habits of the vast quantities of

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WORMS (again with the aid of Sir John Lubbock) which inhabit my grass-plot; or those of the SNAILS; or of the SLUGS, which exist in equally innumerable quantities in the garden soil. Both these latter classes of animals appear to be made to be eaten, as they largely furnish food for the birds. They prefer damp or wet weather, and to some degree are excellent weather-glasses or weather prophets. As we all know, they roam or sail about on rainy evenings. But it is curious to observe also the special instinct by which in dry periods the Snails will become aware of watered or damp earth at a considerable distance, and how they will in the night cross a large breadth of dry, or even dusty earth, to reach a spot of ground where plants had been watered on the previous evening. I need scarcely remind you that these land mollusks, the Snails, and still more the Slugs, are creatures with super-excellent appetites for the garden plants.

I have now, in conclusion, not only to apologise to this Society for the length of my paper, but, perhaps, also for having brought it before you at all.

I did not venture to do so until I had asked our excellent and experienced Secretary whether he considered that a few such popular or surface notes, even if containing little that is new, would be acceptable, or even appropriate, to such a learned body. My real object has been less to state what I have personally observed than to show what a large field still exists in our City centres (as indeed everywhere) for a naturalistic use of whatever out-door opportunities are present; and to illustrate the principle that even in the smallest and least promising city gardens or spaces, the materials for interest and self-instruction are ever present, and practically inexhaustible; that here, as elsewhere, and everywhere, we may "read, and read again, and still find something new; something to please, and something to instruct."

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V.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1899.

By Thomas Southwell, F.Z.S., V.-P.

Read 27th February, 1900.

So far from there having been any material falling off in the number of visitors to the Museum after the first two years of its abode in its new home, which, as might have been expected from the novelty of the thing were exceptionally large, the return for 1899, the fourth complete year, shows a small increase over that preceding it, 129,106 visitors having passed the turnstiles. The attendances on pay-days have been the largest in the four years, and the same may be said of the visitors to the architectural features of the building, which are separately shown, this number having maintained an annual increase, till in the past year it has reached a total of 7,603, being 1,749 more than in 1896, the first complete year. This result is very gratifying, showing that those who prove their interest by paying the small charge for admission, as compared with the mere sightseers, have steadily increased.

There have been no very striking additions to the Natural History Collections during the past year, but this has been amply atoned for in the splendid additions to the Picture Gallery, through the munificence of the late Mr. J. J. Colman, and the addition of the large collection of forest-bed fossils accumulated by the same gentleman, and presented last year by his son, Mr. Russell J. Colman. This latter has necessitated the building of a gallery in the Geological Room similar to that in the Raptorial Bird Room, which is now in a forward state, and the re-arranging of the whole collection will be proceeded with without delay.

In the Mammalian Room the chief addition is the head of a Musk Ox (*Ovibos moschatus*), killed by the Whaler "Polar

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Star," on the East Coast of Greenland in June, 1898. Until the past few years, when the exceptional condition of the ice in the Polar Seas has rendered the approach to the Greenland Coast possible, very few of these animals have been obtained, and they were rarely to be met with in Museums. The British Museum has some fine examples brought from Grinnell Land by Colonel Feilden, otherwise they are badly represented. Our specimen is the head of a young male not quite mature.

In British Ornithology we have received a good specimen of the variety of the Common Partridge known as *Perdix montana*, distinguished by the prevalence of rich brown colour, and the absence of the horse-shoe patch on the breast, several examples of this variety have been killed in Norfolk. A young Montagu's Harrier, taken from a nest at Freethorpe in July, 1875, has also been received, and the Marchioness of Lothian has been good enough to send us a fine example of a Hybrid between the guinea-fowl and a domestic fowl. I would also draw attention to a new case of Rooks, with their nests, eggs, and young, in the corridor leading to the British Bird Room.

Mr. Gurney has been kind enough to furnish me with the following notes on the additions to the Birds of Prey:—

"No new Diurnal Birds of Prey have been added to the Castle-Museum during 1899, but I obtained several valuable eggs from the Leopold Field Collection, among which those best worth mentioning are:—

Gyps bengalensis, 3.
„ kolbii, 1.
„ africanus, 1. Sennar, T. Allen.
Haliastur indus, 1.
„ leucosternus, 1.
Thalassaëtus pelagicus, 1. Dr. Middendorf, June 21st, 1869.
Haliaëtus leucocephalus, 3.
„ leucoryphus, 1. Kakha River, Crimea, April 2nd, 1869.
Tinnunculus newtoni, G., 3.
Aquila mogilnik, 2.
„ adalberti, 1. Granada, March, 1876.
Astur hensti, 1. Fandrasa, Madagascar.
Accipiter fuscus, 3.
Asturina plagiata, 2. Maxathan, Mexico, April 13th, 1881.

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It will be seen that several of these eggs are interesting for locality's sake, besides being new to the collection, which is rather deficient in this branch, indeed, until the last fifteen or twenty years, authenticated eggs of Birds of Prey, not European, were unobtainable.

The New World Owls are now divided by trinomalists into several geographical races, and as this is done by recognised authorities, each race requires representation in a complete collection of the *Strigidæ*. Mr. C. K. Worthen, the well-known dealer, who has had my order on hand some time, has now obtained from his collectors three more of these sub-species, if not four.

I. *Bubo virginianus pallescens*, Stone, ♀, Riverside, Colorado, October 21st, 1897. This is a smaller race of the well-known *B. virginianus*, and paler.

II. *Megascops asio macfarlanei*, Brewst., ♀, Logan, Oregon, December 4th, 1898. A form characterised as being of the size of *M. kennicotti*, but with the colour of *M. bendirei*.

III. *Megascops asio aikeni*, Brewst., ♀, Rocky Ford, Colorado, March 16th, 1898. Size of *M. bendirei*, with ground colour more ashy. Cooke says of it in his 'Birds of Colorado,' on the authority of Mr. Hasbrouck, that it does not go north of Douglas country, and is not found below 5,000 feet.

Speotyto (pholeoptynx) cunicularia obscura, Steph., ♀, Sacramento, California. The characters of *S. c. obscura* are not sufficiently well founded to give it a place in the A. O. U. check-list ('The Auk,' 1899, p. 131), but the other three species are admitted, and, no doubt, stand on a somewhat better basis.

Seven sorts of Owls' eggs were also received in the Field collection as follows:—

Two Scops bakhamæna. Akyab, April 7th, 1883.
One „ japonicus. Oudh.
Three „ sunia. Neilgherries.
Two Speotyto cunicularia. Chili.
Three Urrua bengalensis.
Two Bubo virginianus.
One Ascalaphia coromanda. Delhi.
One „ „ N. W. Provinces."

Among the few additions to the collection of Foreign Birds is a specimen of the Spotted Tinamou (*Nothura maculosa*), kindly

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presented by the Zoological Society, which is very acceptable, as the singular family of the Tinamidæ is poorly represented in our collection.

Mr. Gurney has already referred to the valuable eggs of Birds of Prey, for which the Museum is indebted to his liberality. To these there is only one important addition, it is a British Egg of the Kite, taken at Alconbury, Huntingdonshire, a former breeding-place of this species.

In the department of Botany there has been added a collection of Dried Plants from Australia, America, and Europe, mounted and named, with a MS. catalogue by the donor, Miss A. M. Barnard, who long had charge of the collections in the old Museum as their Hon. Botanical Curator. All botanists should visit the Picture Gallery to study the beautiful "Study of a Burdock," by John Crome, a picture replete with interest not only from an artist's point of view for its perfect harmony of colouring, the beauty of the drawing of the foliage, and its simple yet effective grouping, showing how much a true lover of nature and an accomplished artist could make of even so simple a subject, but also from the absolute faithfulness of delineation so often obscured in producing forced, so-called artistic, effects.

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VI.

NOTES ON THE HERRING FISHERY OF 1899.

By T. J. Wigg.

Read 27th February, 1900.

I have been requested to put together, as concisely as possible, some notes which I have been able to obtain concerning the Herring Fishery of 1899. It was with a feeling of great reluctance that I agreed to do this, as I felt that I was not, and could not be, so closely in touch with the subject as those who have written the notes in former years. However, rather than allow the year to pass without the usual record, I consented to do what I could in the matter.

May I, therefore, crave your indulgence while I try to place before you the few facts which I have been able to gather concerning the most important (to Yarmouth at least) industry of the year.

I am very pleased to be able to speak of 1899 as a record year in several ways. (1) The number of fish caught; (2) the prices obtained; and (3) of the few lives lost in prosecuting the capture of the Herring.

At the commencement of the season, fishing was very slow, and prices were about three times as high as in 1898. There were a great many more buyers than usual, and prices went up to £18 or £20 a last.

The Scotchmen were rather late in arriving at this port, as they were evidently loth to leave Scarborough, where some were reported as doing very well. Probably the real reason was their dread of bad weather. During the second week in October the boats were in full working order to the number of 338, made up as follows:—

Home boats	...	...	138
Scotch „	...	...	200

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In working these boats, over 3,000 men and boys were employed.

The number of Home boats was the same as last year; one or two which had dropped out being replaced by new steam-luggers. The number of Scotch boats was an increase of about 15 on last year. They came from the following ports:—Arbroath 2, Banff 50, Berwick 19, Fraserburgh 16, Inverness 22, Kirkcaldy 36, Leith 31, Montrose 10, Peterhead 4, Wick 10.

During October some splendid catches were effected by both Home and Scotch boats. I have been able to obtain analyses of the biggest catches, which are as follows:—

1	boat had	23 lasts.	
3	boats had	17 lasts	each.
2	,,	16 ,,	
6	,,	between 14 and 15 lasts	each.
14	,,	,, 12 and 14	,,
11	,,	,, 10 and 12	,,
10	,,	,, 8 and 10	,,

Analyses of the Scotch catches:—

1	boat had	13 lasts.	
2	boats had	between 12 and 13 lasts	each.
5	,,	,, 10 and 12	,,
43	,,	,, 7 and 10	,,
42	,,	,, 6 and 7	,,

As an illustration of the cosmopolitan character of the Fish Wharf at this time of the year, it may be mentioned that one day some cause for slight altercation arose between the crews of some of the boats lying there. Those concerned represented the following nationalities:—English, Scotch, and French, and in addition a Dutchman was acting as interpreter.

As I have before stated, the '99 fishery was a record one for quantity of fish, and for prices obtained by the catchers. The Yarmouth season was later in commencing, probably owing to the exceptionally hot summer retarding the Herrings in their southward migrations. The Scotch fishing at Stornaway was practically a failure; yet, at the close of the season there, and when most of the boats had left, huge shoals put into those waters. Later the fishing on the East Coast of Scotland was likewise a failure, the Herrings during the recognised season being very scarce; but after the majority of the boats had left for the south at the usual periods, vast shoals of Herrings were met with by the few boats remaining at Peterhead, Fraserburgh, Aberdeen, &c., but they

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came too late, as the merchants had left for the south. The fishing off North Shields, Scarborough, and Grimsby appears to have suffered in like manner. The Yarmouth or Home Voyage was about three weeks later than usual in making a beginning, but the Herrings remained on the coast longer; indeed, several boats fished quite up to December 22nd, which was very unusual.

The failure of the Scotch fishing was mainly responsible for the high average prices made by the Herring during the Yarmouth voyage. Speaking generally, the Herrings were not of such a high quality as in former years.

Here are a few facts to show how remarkable the season of 1899 was:—

I. There was not a single night during the voyage when it was impossible to fish owing to rough weather.

II. Herrings in greater numbers than ever were pickled and exported to Russia, Germany, Holland, and other parts of Europe, while large quantities of cured Herrings (known as "Reds") were exported to the United States, Egypt, the Levant, Italy and Jerusalem, or Jericho.

III. Scarcely an instance is recorded of loss of, or damage to, gear. This is quite unique, as is also the fact that during the whole season only three lives were lost.

IV. There was not, as in previous years, a great glut on one or two days, but there was a large steady delivery throughout the season, and prices ruled high, whether deliveries were large or small.

V. The extraordinary scenes witnessed on the South Denes, where nearly 800 Scotch girls and women were busily employed in preparing the Herrings for export by gilling and drawing them in preparation for the barrels into which they are packed. The women are remarkably adroit, and perform their work in about one-third of the time required by our local women.

In addition to the females engaged, there was a great number of men who were very busy in heading the barrels after they had been filled with "Matties," as the prepared Herrings are called. These operations were occasionally carried on into the night, and the sight of the Denes, with the flare of the flickering paraffin lamp, the glare of the electric light, the women and men working as hard as possible, and the noise of carts and carters, made a scene which was at once grotesque and weird.

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"What becomes of all this mass of fish is doubtless of interest to a wide circle immediately beyond the confines of trade circles. The great bulk travels abroad, and the Continent is unmistakably Yarmouth's best customer. The Herrings cross the seas in two forms, principally "pickled," that is soaked in brine, in which condition they form an acceptable article of winter diet among the poor of Russia, Germany, Belgium, and Holland at a period of the year when fresh vegetables are scarce. In other forms, that is lightly salted and smoked, they take another direction and go further afield to the Italian ports of Genoa, Leghorn, Naples, &c., to Venice and the Adriatic, to Malta, and beyond to the Levant. Some this year even went to Jericho. We also learn that a consignment of about 2,000 barrels crossed the Atlantic to New York, a destination to which about the same quantity has been sent for several years past, and this is some evidence that Yarmouth Herrings are finding favour, and a certain vogue even with Brother Jonathan. The table of figures appended shows the quantity despatched to foreign ports from Yarmouth direct, and what a stupendous development this trade has had in the past year is seen in the fact that the increase upon the figures for 1898 is only 4,000 barrels short of 100,000. The number of steamers required to convey all this fish must have benefited the port revenues of Yarmouth substantially, and also all the trades dependent upon supplying and providing for shipping. The total direct export for 1899 is accompanied by the figures for the past eight years for the sake of comparison :—

1891	...	8,800 barrels.	1896	...	13,565 barrels.
1892	...	11,744 „	1897	...	61,677 „
1893	...	7,500 „	1898	...	45,872 „
1894	...	15,911 „	1899	...	141,585 „
1895	...	23,119 „			

"In addition to all these thousands of barrels shipped direct from Yarmouth, there is the coastwise trade. There are two steamers on the Hull station running in each direction twice a week during the fishing, and from Hull radiate the long and short sea routes of the famous Wilson Merchant Fleet. A big proportion of these vessels, all of whose names end in an "o," carry Yarmouth Herrings, and the bulk of the figures given below are probably Wilson liner shipments from Hull, but in addition a few cargoes also went to

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Leith and some other North British ports, where they were dealt with and shipped by Scottish exporters. The coastwise figures are :—

1891	...	13,237 barrels.	1896	...	15,985 barrels.
1892	...	16,857 „	1897	...	23,876 „
1893	...	15,500 „	1898	...	18,861 „
1894	...	17,170 „	1899	...	25,711 „
1895	...	11,610 „			

From 'Daily Press,' 13th January, 1900.

RETURN OF HERRINGS LANDED AT YARMOUTH IN 1899.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	345
February	—	July	165
March	—	August	562
April	39	September	1,560
May	76	October	10,808
June	230	November	12,701
		December	819
Carried forward	345	Total	26,960

October	6,073 +	4,735 Scotch.
November	7,046 +	5,655 „
December	799 +	20 „

RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1899.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	1,225
February	—	July	246
March	68	August	17
April	399	September	92
May	373	October	7,435
June	385	November	8,687
		December	1,255
Carried forward	1,225	Total	18,957

Number of Lowestoft boats	218
„ Scotch „	103
„ West Country boats	13
	334
Hands employed on the boats	2,870

NOTES BY MR. A. PATTERSON.

ONE of the most remarkable things connected with the recent Herring fishery was the marked absence of their natural and most formidable enemies, such as the Cetaceans, Sharks, &c. Usually a number of Porpoises and Sharks are entangled in the nets, and

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on one occasion as many as five large Sharks (Porbeagles) were lying on the Fish Wharf at one time. Last season only one Porpoise was brought in, and one Porbeagle Shark (*Lamna cornubica*), a species which has of late years been far more in evidence than the Blue Shark (*Corcharius glaucus*). In some years the Piked Dog (*Acanthus vulgaris*) is abundant, but was exceedingly scarce in 1899, and the usual admixture of Whitings were conspicuously absent, the immense shoals of Herrings having the place almost entirely to themselves, even to the exclusion, to a great extent, of the Mackerel shoals, which in previous years had been arriving in Autumn in increasing numbers. Two or three Anchovies (*Engraulis encrasicholas*) were taken. Gannets, Guillemots, Gulls in abundance, and several other species of Herring-loving birds, were met with as usual.

VII.

METEOROLOGICAL NOTES, 1899.

(From observations taken at Bradestone House, Brundall, Norfolk.)

By Arthur W. Preston, F. R. Met. Soc.

Read 27th January, 1900.

January.

This was a very mild month, although the mean temperature was 1.4 degrees lower than that of January, 1898. With that exception there has been no other January so mild since 1884. The wind was almost continuously in a south-westerly direction till the 23rd, and at times blew very strongly, accompanied by squalls of rain. The heaviest gale was on the 13th, but a very windy period was from the 18th to the 22nd, during a considerable part of which it blew at gale force. From the 23rd to the end of the month the

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weather was of a distinctly different type, with northerly and north-easterly winds, and a decided fall of temperature, the day readings being generally about 10 degrees lower than the prevalent value during the first three weeks. The Winter Aconite made its first appearance on the 19th, or eighteen days later than the previous year, and the Snowdrop on the 28th, or nineteen days later, notwithstanding that the temperature of the Autumn and early Winter had been much higher in 1898 than in 1897. This is somewhat singular, and can only be explained by the drought of the previous August and September preventing the commencement of growth at the usual time, which would accordingly seem to be earlier than is generally supposed. The fact is worthy the attention of Horticulturists.

February.

The month entered with some slight snowstorms and a little frost, but of no long duration, the weather soon becoming mild and squally again. From the 8th to the 14th it blew hard from the south and south-west, with but little intermission, although the wind did not here reach the force of a gale on each day. There was hardly any rain after the 15th, and the remainder of the month was bright and mild by day, with morning and evening frosts. The thermometer reached 63.6 degrees on the 10th, which appears to be the highest reading recorded in the first half of February during the present century, although 64 degrees was recorded on the 28th in 1846 and 1891.

March.

To the 17th this month was fine, mild, and dry, the thermometer on the 11th rising to 62.2 degrees, and the rainfall of this period amounted to 0.13 in. only. An abrupt change to cold, rough weather occurred on the 18th owing to the arrival of a cyclonic disturbance over the North Sea, where it became nearly stationary for some days. Snow fell daily from the 18th to the 23rd, the fall on the night of the 19th, which registered, when melted, 0.73 in., being the heaviest for some years. The snow laid about six to eight inches deep on the level, and the country presented the appearance of the depth of Winter. On the 21st the thermometer fell to 14 degrees in the screen, and to 9.4 degrees on the grass, which severity had

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not been approached since the hard Winter of 1895; indeed, the lowest readings of the thermometer since that date had not been below 21 degrees. On the 25th a heavy rain quickly cleared away the snow, and by the 29th the thermometer had again reached 60 degrees.

April.

This was a cloudy month, with more rain than usual. The total rainfall for the month was 1.21 in. above the average, and the heaviest recorded for April since 1882. Although the mean temperature was well up to the average, vegetation was backward through want of sunshine. Thunder was heard on the 8th, hail fell on the 8th and 11th, and snow on the last-named date. The Cuckoo was heard in full song on the 18th, and the Nightingale a few days later.

May.

Ungenial weather prevailed throughout the greater part of the month, with harsh northerly and north-easterly winds. There were but few even moderately warm days, and, as in May, 1898, the thermometer did not once touch 70 degrees. The rainfall was slightly above the average, but it was nearly all registered between the 14th and 25th. There were some heavy thunder-showers at times during that period, but as these storms were invariably followed by bleak, drying winds from a cold quarter, vegetation remained backward, and the Spring was, at the close of the month, considerably behindhand.

June.

A drought set in at the end of May, and continued without intermission until June 18th, a period of twenty-two days. Temperature, which had been so low during May, took a sudden bound with the entrance of June, and some of the earlier days of the month were very warm. An abrupt fall, however, took place at the end of the first week, with the advent of north-easterly winds, and the day temperatures, which had been as high as 81.2 degrees on the 5th, and 76 degrees on the 6th, fell to 54.6 degrees on the 8th. The mean temperature of the month was in close agreement with the average; there were many bright sunshiny days, particularly during the first

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half of the month, and, except perhaps to the farmer and gardener, who wanted more rain, it was as fine a summer month as could well be wished for.

JULY.

It is but seldom that so fine and warm a July as that of 1899 has to be recorded. Such a long succession of bright, warm days is but rarely met with even in the finest summers. At times the heat was very intense, the thermometer exceeding 75 degrees on thirteen days, and 80 degrees on four days, the highest point touched during the month being 85 degrees on the 20th. But the day temperatures were not so exceptional as those of the nights. On six occasions the thermometer failed to fall below 60 degrees, and many other of the minima were nearly as high. The mean minimum temperature for the month was 55 degrees, which is considerably higher than in any July since 1884. Nearly the whole month's rainfall occurred on the 22nd and 23rd, the amounts gauged at Brundall being respectively 0.50 in. and 1.06 in. on those two days. So dry was the soil that this heavy fall of rain was soon absorbed, and, being followed by a renewal of the dry weather, the ground at the end of the month was nearly as parched as before the downpour reached us. A somewhat severe thunderstorm occurred on the morning of the 23rd, but there was an unusual absence of electrical disturbance during the greater part of the month.

AUGUST.

The same dry, fine weather, which characterized the entire Summer, continued throughout August, broken only by a severe electric commotion on the 15th, and some thunder-showers on the last three days of the month. Such a prevalence of bright, sunshiny days has not been recorded for many years. The maximum temperature would have been higher on many days (as was the case further inland) had it not been for the prevalence of easterly and north-easterly breezes, which considerably subdued the heat. The rainfall at Brundall was only 0.76 in., or 1.76 in. below the average. A third of the amount fell during the thunderstorm of the 15th. This storm varied much in its severity in different localities, as much as 2.84 in. of rain having been gauged at Wereham, in West Norfolk, during its progress.

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September.

For two years in succession the very unusual fact has to be recorded of the hottest day of the year occurring in September, and this, notwithstanding the large number of warm days which were experienced during the Summer of 1899. On the 5th the thermometer rose to 87 degrees, which, although 2 degrees lower than on the 9th September, 1898, was an extraordinarily high reading for so late in the season. The second week of the month gave fine but cooler days, but from the 15th the weather was cool and unsettled, and at times chilly and winterly. On the mean the temperature of the month was about the average, the coldness of the latter part counter-balancing the great heat of the earlier days of the month. Rain fell on nineteen days, against four in 1898; and on some occasions the falls were rather heavy. Thunder and lightning occurred on the 2nd, 6th, and 27th, and lightning was seen on several evenings during the last week of the month. A short but sharp gale of wind occurred on the early morning of the 22nd, and the barograph disclosed a rapid fall of the mercury during the night and early morning of that day, which, being succeeded by an equally quick rise, would not have been noticed by the ordinary 9 a.m. and 9 p.m. readings. The most violent gusts occurred about 4.30 a.m., just at the time of the lowest pressure. The following were the hourly barometric readings during the night and early morning:—

Sept. 21st, 9 p.m., 29.76 in.	Sept. 22nd, 4 a.m., 29.34 in.
„ 10 p.m., 29.70 in.	„ 4.30 29.32 in.
„ 11 p.m., 29.65 in.	„ 5 a.m., 29.34 in.
„ Midnight 29.60 in.	„ 6 a.m., 29.43 in.
Sept. 22nd, 1 a.m., 29.55 in.	„ 7 a.m., 29.50 in.
„ 2 a.m., 29.48 in.	„ 8 a.m., 29.54 in.
„ 3 a.m., 29.40 in.	„ 9 a.m., 29.58 in.

October.

Rainy weather continued till the 5th inst., when another fine period set in, lasting three weeks, and proving an agreeable supplement to an exceptionally fine Summer. During this period the thermometer rose to 60 degrees and above on ten days, and although there were at times morning and evening fogs, cloudless skies were the rule rather than the exception. The mean temperature of the month was about normal, but 5 degrees

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lower than that of the previous October. The rainfall was three-quarters of an inch under the average, and the general force of the wind was very low; in fact, so quiet an October, with a complete absence of gales and strong winds, has been but rarely recorded. The Autumn tints were unusually beautiful, and there was an abundance of garden flowers throughout the month.

November.

The month entered with rainy, stormy weather, and it threatened to be an abnormally wet November. On the 12th, however, a sudden and unlooked-for change took place, and the unsteady barometer of the earlier days gave place to a period of very high pressure. During the remainder of the month the barometer never once fell below 30.17 in., and on the 17th attained 30.72 in. There was practically no rain after the 11th. Temperature was high throughout the month, and on the mean was higher than in any November since 1881. There was practically no frost, and the day temperatures exceeded 50 degrees on twenty-three days, and 60 degrees on three days. The result was that garden flowers held on to an extraordinarily late period, and I had a bed of show and fancy Dahlias in full bloom throughout the month. A violent squall, accompanied by hail, thunder and lightning, occurred about 2 p.m. on the 11th, and during its passage great and unusual darkness occurred, making it almost necessary to resort to artificial light.

December.

This month was chiefly remarkable for the unusual severity of the ten days from the 8th to the 18th, when lower temperatures were registered than in any December since 1890, the thermometer falling to 13.5 degrees on the 12th, and 13.0 degrees on the 16th. These readings were as low as any in the cold December of that year, but the mean of the month (35.9 degrees) fell considerably short of 1890, when it was 30.3 degrees. It was a little higher also than in 1892, in which year, however, there were no such extremely low readings as in the month under review. After the frost broke on the 18th the weather was very changeable to the end of the year. A great barometric depression occurred on the 29th, the

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barometer falling at 7 p.m. to as low as 28.50 in., being the lowest recorded here since December, 1886. It was accompanied by a gale, but of less severity than has sometimes been experienced with a higher barometer. The rainfall of the month was about half an inch deficient. Snow fell on four days, but no very heavy falls occurred, although the ground was covered with snow for eight successive days.

The Seasons.

The following Tables show the mean temperature and rainfall for the four seasons, together with those of the five previous years, and of a twenty-year approximate average. Winter comprises the three months December to February inclusive; Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1894.	1895.	1896.	1897.	1898.	1899.	20-year average.	Departure of 1899 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	39.2	34.7	39.6	38.3	41.3	42.6	37.8	+ 4.8
Spring ...	47.7	47.6	48.0	46.9	45.8	46.2	46.2	0.0
Summer ...	59.3	60.4	61.1	61.9	59.7	61.9	60.2	+ 1.7
Autumn ...	50.1	51.4	48 5	50.3	54.0	51.2	49.5	+ 1.7
Year	49.2	48.4	49.3	49.5	50.5	49.8	48.4	+ 1.8

RAINFALL.

Seasons.	1894.	1895.	1896.	1897.	1898.	1899.	20-year average.	Departure of 1899 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	4.81	7.35	3.28	7.86	4.11	5.82	6.02	— 0.20
Spring ...	5.62	4.15	5.18	5.05	6.18	6.84	5.21	+ 1.63
Summer ...	8.74	7.51	4.88	4.17	6.90	3.52	7.17	— 3.65
Autumn ...	7.12	7.13	8.49	6.42	5.65	8.31	8.50	— 0.19
Year ...	27.32	24.91	23.28	22.07	23.33	23.94	26.90	— 2.96

It will be seen from the above that the temperature of the Winter was largely in excess of the average. No Winter has been so mild since my observations were commenced in 1883, the nearest approaches having been 1883 –4, with a mean of 40.4 degrees, and 1897—8, with 41.3 degrees. In fact, we have to go back to 1876—7 for a Winter of so high a mean temperature. The Spring

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gave a mean temperature coinciding with the average. The Summer temperature was high, but did not, on the mean, exceed that of 1897 owing to the prevalence of easterly winds on some days, which were exceptionally warm further inland. The Autumn was mild, but less so than in 1898. The rainfall was deficient in each season except the Spring, which gave an excessive fall of rain. The Summer was so exceedingly dry that the amount of rain was less than half the average. No Summer has given so small a rainfall since 1885. The Autumn fall was normal.

The Year.

The chief features of the year were an abnormally mild Winter, followed by a somewhat coarse and ungenial Spring, giving place at the advent of June to a Summer of almost unsurpassed beauty. The long continuance of bright, sunshiny days, the warm nights, and the almost entire absence of any bad weather to mar the enjoyment of outdoor entertainments, will long be remembered. The Summer may be said to have consisted of practically unbroken fine weather from the 1st June to the middle of September, with a second edition in October. The absence of frost in November assisted to prolong the season, but December was accompanied by much severe weather, and was generally more winterly than for several years past. The Summer may be classed with those of 1818, 1825, 1846, 1859, and 1868 as one of the finest, hottest, and brightest of the century. The rainfall of the year was, for the fifth year in succession, below the average, the deficiency having been, in 1895, 1.99 in.; in 1896, 3.62 in.; in 1897, 4.83 in.; in 1898, 3.67 in.; and in 1899, 2.96 in., or a total deficiency of 17.07 in. in the five years.

It may be mentioned that the instruments of this Station were examined by the Royal Meteorological Society's Inspector during the year, and were found in proper working order.

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1899.

Month.	Barometer. Highest.	Date.	Lowest.	Date.	Mean.	Thermometer. Highest.	Date.	Lowest.	Date.	Mean.	Hygrometer. Mean Relative Humidity, 9 a.m.	Cloud. Estimated proportion	Rainfall. Inches.	No. of days.	Wind. Direction. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W	Mean estimatd force
Jan. .	30.72	26	28.86	2	29.805	56.0°	21	24.6°	6	41.7°	88	6.6	2.24	22	4	3	3	1	4	10	6	0	3.3
Feb. .	30.65	28	29.22	12	29.916	63.6	10	23.8	28	41.9	85	5.6	1.27	16	1	1	5	5	6	5	2	3	3.3
March	30.60	13	29.02	9	30.060	62.2	11	14.0	21	40.9	85	5.9	1.99	17	4	3	0	2	2	4	10	6	2.9
April	30.32	22	28.89	14	29.796	62 2	2	32.0	12	47.2	89	7.6	2.88	19	4	1	1	1	2	6	8	7	3.4
May .	30.47	6	29.37	15	30.021	69.0	31	30.6	1	50.6	79	6.4	1.97	16	6	8	2	0	5	4	2	4	3.3
June .	30.46	8	29.48	20	30.075	81.2	5	38.4	1	58.8	78	5.0	0.89	9	6	6	4	3	4	1	2	4	2.4
July .	30.50	31	29.47	1	30.107	85.0	20	48.6	18	63.9	74	5.2	1.87	6	2	2	3	5	2	8	2	7	2.8
Aug. .	30.46	1	29.75	31	30.125	84.0	15	46.0	11	63.0	76	4.4	0.76	7	1	8	7	5	1	1	3	5	2.4
Sept. .	30.20	3	29.34	30	29.837	87.0	5	33.6	29	57.1	81	6.7	3.29	19	1	1	2	0	6	4	7	9	3.3
Oct. .	30.46	19	29.26	1	30 073	65.2	12	29.8	20	49.3	89	5.3	2.30	12	1	1	4	6	5	4	5	5	2.0
Nov. .	30.72	17	29.36	8	30.165	61.0	10	31.6	18	47.3	92	7.4	2.72	12	1	0	2	1	4	3	11	8	2.8
Dec. .	30.53	3	28.50	29	29.915	53 2	1	13.0	16	35.9	93	7.7	1.76	19	1	2	7	3	5	3	4	6	1.9
Means					29 991					49.8	84	6.1											2.8
Extremes & Totals	30.72	Jan. 26 Nov 17	28.50	Dec. 29th		87.0	Sept. 5th	13.0	Dec. 16th				23.94	174	32	36	40	32	46	53	62	64	

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VIII.

NATURAL HISTORY NOTES FROM YARMOUTH.

By A. Patterson.

Read 27th March, 1900.

1899.

The latter part of March of this year was characterized by unsettled weather, snow being frequent. Redwings were not much *en evidence* during the winter until this period, when their notes became familiar; these were, no doubt, birds on their northward journey arrested by the inclemency of the weather.

I have but one new species of fish to record, viz., the Gattorugine (*Blennius gattorugine*) [*vide* May 21st].

The majority of my notes, it will be found, refer to occurrences of birds, &c., on Breydon. My house-boat being moored in a rond in a very interesting corner of that famous "Broad," I have spent many nights there, hence the opportunities of observation afforded me.

On April 3rd I saw a Hooded Crow on a mud-flat; an exceptionally late bird. For many months a slightly wounded example has frequented the Bure marshes.

April 12th. A Sturgeon, nearly 8 ft. long, weighing about 6 stones, brought to the Fish Wharf.

On April 17th, and following day, a Spoonbill came to the Breydon mud-flats. Two more on (or about) the 22nd.

April 26th. A 24-in., 4 lb. 2 oz., Grey Mullet (*Mugil capito*) taken in a draw-net on the beach.

The Oyster-catcher has of late years become a much less frequent visitor here. Several on Breydon on April 27th. This species, as a rule, prefers the beach.

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April 28th. During the demolition of an old chimney in Howard Street fifteen skeletons of Jackdaws were shown to me, lodged in a recess, wherein, as nestlings, they no doubt had fallen and died—it may be from suffocation. At the present time Jackdaws nest nowhere in the town, although I think their cousins, the Starlings, do so increasingly.

A Gull, which I supposed at the time to be an Iceland Gull, was flying, in company with other species, quite near me on Breydon. It remained some days, and then disappeared: this was the first week in May. I heard afterwards that it was shot, and is stated to be an Albino example of *Larus canus* [*vide* 'Zoologist,' 1900, p. 104].

May 10th. A few Godwits on Breydon.

On the same date six Spoonbills, which had frequented Breydon since the 8th, allowed me to row within thirty yards of them before they flew to another "lump." There was a marked correspondence in their actions, each raising one leg, and craning the neck simultaneously, with military precision, before taking to flight, which was performed in silence, and in a straight line, one following the other. Of all the Spoonbills I have been fortunate enough to keep or see, I never heard one utter any cry whatsoever. But Mr. Gurney ['Zoologist,' 1900, p. 104] mentions the fact of hearing "two Spoonbills in confinement, which had been dumb for a long time, suddenly, under the influence of a warm day, began a rather feeble duet." Saw nineteen Godwits and a Greenshank same date.

May 12th. A small Albino Brill, with red-brown rings encircling the eyes.

May 18th. Myriads of the larvæ of the *Tipula*, or "Daddy Long-legs," turning up on the grass on the Beach Gardens, which they ravaged. The Sparrows would not look at them [*vide* September 5th].

The only species of fish new to this locality that has come to hand since last year, was brought to me on May 21st by a Shrimper, viz., an example of the Gattorugine (*Blennius gattorugine*) which measured 4 inches in length. This is an interesting addition to the Norfolk List.

May 25th. Counted sixteen Turnstones on the Breydon flint-walls. When undisturbed they nimbly hunted among the Bladder-wrack in search of *Gammarus marinus*, desisting each time I rowed

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nearer to them, when their colours so nearly assimilated to their surroundings that no one would have detected their proximity had the birds not been located when on the move.

June 1st. Thirteen Knots, two Curlew-sandpipers, one Greenshank on a mud-flat.

Three Pilchards (*Clupea pilchardus*) were taken in a draw-net on the beach on June 3rd.

June 5th. Many hundreds of large *Nereid* Worms swimming on the surface of Breydon this lovely evening at high water, the sexual instinct undoubtedly prompting them to leave their tunnels in the mud-flats.

June 15th. A Grey Plover on Breydon, an unusually late appearance of this species.

June 20th. Two Arctic Terns on Breydon; also a number of richly-coloured Ringed Plovers.

A flock of about 400 Dunlins flew past the door of my house-boat on Breydon on the evening of June 22nd.

A most interesting experiment was made during the third week in June by one of Hewett's steam trawlers, which trawled in the Bay of Biscay. The ground proved to be very rough and unsuitable for working, and the catch created more interest than profit; the experiment was not repeated. Roughly counted, the following fish were sold on the Wharf:—

50 Dorys.
100 Sea Bream.
3 (trunks) Piper Gurnards.
500 Hake.

Amongst the fish distributed in various fish-shops from this sample, I obtained a Greater Forkbeard (*Phycis blennoides*) 14½ inches in length, and saw others; there were also several examples of the Bergylt. The Piper (*Trigla lyra*) has not yet been recorded for this locality.

June. The Humming-bird Hawk-moth (*Macroglossa stellaratum*) was very plentiful during the month. On the 21st I observed one hovering over some cut flowers in the Market.

July 10th. Young Herons on Breydon.

The Ringed Plovers have been at last driven from their old nesting quarters on the North Beach. A nest was discovered, however, this month on the South Beach, its three pilfered eggs

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being shown to me on this date. The fellow who took them appeared to think he had performed a praiseworthy deed.

On the same date a Crab-claw of *Cancer pagurus* was given me, the free part of the nipper-claw had three points in lieu of one.

July 19th. Young Dunlins on Breydon.

Same date two boxes of Bergylts, or "Norway Haddocks," on the Fish Wharf. One specimen weighed 4 lbs., measuring 20½ inches in length. Several between 3 lbs. and 4 lbs. each in weight. As in the case of those previously mentioned, there was small demand for them, a few being purchased rather as novelties than from utilitarian motives. This catch, I believe, was from Icelandic waters.

July 20th. Heard the Golden Plover whistling overhead to-night.

Fifty Redshanks on Breydon, July 22nd. Not so numerous in this locality as last year.

July 24th. A "family party" of seven Common Sandpipers on Breydon, noisily feeding. I am inclined to think them Norfolk bred. I saw eight, the largest party I have yet observed, on August 26th.

A Common Gull choked itself with a Flounder on Breydon on evening of July 30th. I would have helped it, but it managed to get away in the gloaming.

July 31st. A Hooded Crow at Burgh Castle.

An inrush of Curlews took place on August 7th; a few had been with us all summer. Subsequently hundreds made Breydon alive and noisy. Not a few never saw the 1st September.

August 14th. Green Sandpiper on Breydon. This ditch-loving species becomes yearly scarcer.

Early on the morning of August 17th a flock of Black-headed Gulls, on a flat immediately in front of my house-boat, were noisily feeding on the mud-worms, which were evidently frightened to the surface of the mud by a series of peculiar dancing manœuvres performed by the birds.

August 20th. Five Sheld-ducks on Breydon.

August 22nd. A Cormorant passed over Breydon to-day.

Terns were on Breydon unusually abundant during August. A large flock on evening of 23rd. Thirteen more on September 1st; still more on September 3rd.

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September 2nd. A Corncrake caught in a stable in the heart of the town. This species is notorious for turning up in the oddest of situations at and after harvest-time.

I never saw so many "Daddy Long-legs" as swarmed the grassy banks of Breydon in September. They congregated in millions, hanging on the grass-tufts in festoons, giving them the appearance of over-ripe reed-tufts. Up to the 13th they seemed to be merry. On the 17th hosts had perished in the water, beaten down by wind and rain [*vide* May 18th].

September 8th. A Sandwich Tern very reluctantly flew off a floating log in the centre of Breydon.

A Grey Phalarope shot same date.

September 9th. Four Teal in the Market: subsequently they were singularly scarce.

On the same date a ♀ Merlin was brought me, which had been taken on a fishing-smack.

September 14th. *Carcinus mænas* (the Common Shore-crab) has a peculiar habit of hiding in large clusters in the holes perforating the "ronds" on Breydon, more particularly those to which ingress is made through a small aperture, and there remain while the tide is out. They, seemingly, are on the best of terms until the flood-tide tempts them to prowl and fight for possession, or place, and food or prestige. On cutting a rond-edge straight with a spade, I crashed through two or three such colonies.

September 19th. A 10-inch Sole, with only one half of the head on the upper surface showing the normal colour, brought in to-day.

September 19th. A large Crab-claw given me with the lower or fixed portion of the structure armed with an extra point [*vide* July 10th].

Durrant, the poulterer, had a Great Snipe for sale on September 20th. Becoming rarer yearly, the sand-dunes, its favourite resort, being so encroached on and spoiled by traffic. In the 70's it was not unusual.

September 30th. The wind set in extremely rough, with rain, last evening, giving promise of an influx of migratorial Waders. Went up Breydon to-day to see what had turned up: the place swarmed with Golden and Grey Plovers, Ringed Plovers, and Dunlins. Saw a few Turnstones, Greenshanks, and Whimbrel.

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On the same date a fine Anchovy (*Engraulis encrasicholus*), length 7½ inches, was brought in by the drifter "Primrose." Another a few days after.

October 1st. Larks in considerable numbers arriving.

October 2nd. Durrant, the poulterer, had thirty-three Grey Plovers, with three Greenshanks.

On the same date hundreds of Long-tailed Tits in St. George's Park, in the centre of the town.

October 3rd. More Grey Plovers in the Market; two with exceptionally black breasts.

In all, during the first few days in October, Durrant had 270 Grey Plovers brought him. Also two Little Stints.

October 14th. A Lapland Bunting taken on the North Denes.

A dirty-white Water Vole was shot at Burgh Castle on October 18th. Now in Yarmouth Museum.

October 21st. A decapitated Woodcock found beneath telegraph wires.

Whitings (*Gadus merlangus*) were exceedingly abundant during October: Codlings were as conspicuously scarce.

November 11th. A live Shag brought to me on this date, but it refused to eat, and died shortly after.

A decided flight of Woodcocks was noticed on November 12th. A boy killed a tired-out individual with a stone. Three in the Market on the 14th.

November 18th. Two Quails on Durrant's stall, which were shot in neighbourhood. Very rare of late years.

A 4-foot example of the locally rarer Broad-nosed variety of the Sturgeon (*Acipenser latirostris*) was brought in from sea on November 23rd. *Acipenser sturio* is by no means a scarce visitor.

December 6th. Wind S.E., a rough wet night. Numbers of Golden Plovers whistling overhead. Four great "bunches" of these in the Market on the 9th.

December 9th. Three dead Gannets washed up on the North Beach; I also found the remains of three Kittiwakes.

On the same date I saw the largest Stock Dove I ever handled, in the Market; weight 15½ ozs.

December 10th. A 3-inch fall of snow heralded the advent of sharp weather, which continued some days. The first night's frost drove the Snipes into the neighbourhood in great numbers, the

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brackish ditches adjacent to the marshes harbouring them for a day or two, till, being frozen over, the birds are obliged to continue southwards. On the 11th numbers began to arrive in the Market. I at once saw Mr. Durrant, who gave me unrestricted access to his game-book. From notes forwarded to Mr. J. H. Gurney day by day, he compiled the following table, which appeared in his annual "Norfolk Notes" in the March 'Zoologist,' and which I take the liberty of inserting here:—

	Dec. 11	Dec. 12	Dec. 13	Dec. 14	Dec. 15	Dec. 16	
Snipe	47	40	120	43	60	310	{Jack Snipes not separatd
Jack Snipe	17	12	20	—	—	—	
Lapwing	14	6	—	6	12	20	
Golden Plover	10	1	—	—	4	3	
Coot	—	13	40	—	6	20	
Moorhen	—	—	—	—	9	10	
Water-rail	—	—	—	—	3	—	
Spotted Crake	—	—	2	—	—	—	
Heron	—	—	—	—	1	1	
Goosander	—	—	—	—	—	1	
Mallard	4	4	14	—	30	32	
Widgeon	5	5	9	4	14	35	
Pochard	—	—	1	—	7	15	
Teal	—	—	—	—	1	3	
Golden Eye	—	—	—	—	—	3	
Tufted Duck	—	—	—	—	—	17	
Shoveller	—	1	—	—	3	—	
Woodcock	—	—	8	—	1	—	
Curlew	—	—	—	—	1	1	
Dunlin	23	—	40	60	179	336	
Dabchick	—	—	—	—	—	6	

Early in the second week of December bushels of the Radiated Trough-shell (*Macra stultorum*) were, by a scouring tide, washed up on Gorleston Beach. These had tempted a number of carnivorous Ducks, *e.g.*, Scaups, &c., into the neighbourhood.

December 14th. Seven Swans (Whooper?) on Breydon to-day.

December 15th. Amongst the several examples of the Black Rat (*Mus rattus*) received during this winter, but one of the variety, *Mus alexandrinus*, has come to hand.

December 15th. A large Curlew on Durrant's stall; weighed 2¼ lbs.

December 16th. Gardener-sportsmen have had a week's sport amongst the smaller game, notably the *Turdidæ*. The Market

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to-day was festooned with bunches of Fieldfares, Thrushes, Redwings, and Blackbirds. Several Pochards up.

December 19th. A 14-inch 3-bearded Rockling (*Motella tricirrata*) obtained to-day. Another same size brought me on the 20th.

December 21st. Ten Barnacle Geese on Breydon, three of which were shot. This is a most unusual number for this part of the coast.

During the latter part of December many hundreds of Coots, frozen out from the Broads, might be seen feeding on the *Potamogeton*-covered flats on Breydon. Their method of progress was singularly sheep-like, the whole flock going simultaneously, every movement one way or the other being in unison. They had become shy from incessant persecution. On rising, the patter of their feet was louder than that of the Gulls, and they dashed into the water with an impetuosity which flung up spray all round them.

December 27th. In the course of a stroll on the North Beach I found stranded a Gannet, half devoured by Hooded Crows, a Kittiwake, and some Black-headed Gulls. Also a Woodcock, the first of this species I ever saw washed up.

Afternoon of same date I watched a Grey Wagtail hunting amongst the refuse within a few feet of my boat-shed, on the edge of Breydon. A singular habit of this bird is its partiality for any spot it deems a good hunting-ground, constantly returning to it after being disturbed.

December 30th. Snipe, which had woefully fallen off in weight since the middle of the month, have again become plump and in excellent condition: this species I have observed will lose and regain flesh with wonderful rapidity.

1900.

January 6th. A Bittern brought to Market.

January 13th. A Lemon Sole (*Solea lascaris*), length 10 inches, was brought to me to-day, and on the 16th a beautiful Albino of the Common Sole (*Solea vulgaris*), length 11½ inches, came to hand, a very narrow ring of the normal colour only surrounding the eyes.

A Pink-footed Goose brought to Market on January 23rd.

February 19th. A fine ♂ Bewick's Swan in the Market: a second appearing on the 23rd.

Fieldfares appear to have suffered but little during the somewhat

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protracted frost of December; but the recent return of severe weather has proved too much for them, many being found dead under shrubs in the town and neighbourhood.

February 20th. Small bunches of Larks flying over the town in a direct N.E. direction.

February 27th. About fifty Curlews on Breydon.

March 1st. Ringed Plovers fairly numerous on Breydon mud-flats: one flock of fifty, evidently "callers," working northwards.

March 3rd. A Plaice, white on the upper surface, with the exception of the head and pectoral fins, came to hand. The Plaice is not nearly so frequently found colourless as the Brill and Turbot.

March 5th. Large Otter killed at Burgh Castle.

March 22nd. A Cormorant was brought to me on this date, and turned into a wired enclosure, when it immediately mounted a heap of stones and made itself at home. In two or three days it recognised its fish-basket, and in a week's time would catch its fish when thrown to it, with remarkable accuracy, trumpeting its approval in strange harsh notes. "Joey" soon learned to distinguish my voice, and to judge of my intentions. He gives decided preference to Whitings, Whiting-heads being even more acceptable than cut-up Flounders. Gurnards are preferred to Herrings. After getting his fill he hops on to a favourite stone, and resumes his usual occupation—meditating. If, at one o'clock, he is surfeited with some four or five Whitings, the tail of the last one still protruding from the corner of his bill, for want of room, at two o'clock he will manage easily to swallow another couple. Digestion is remarkably rapid, 3 to 4 lbs. of fish daily are devoured. He does not vomit the bones of fish, as did my Shag; his "mill," indeed, "grinds exceeding small." I have not as yet observed him drink, or pretend to bathe, although his plumage is kept clean and well groomed. He, however, does not object to water thrown over him.

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IX.

SIR THOMAS BROWNE AS A NATURALIST.

By W. A. Nicholson, *Hon. Sec.*

A proposal having been made in Norwich to raise a memorial to Sir Thomas Browne, it might be interesting to bring before our members, a few thoughts bearing more particularly on his writings on Natural History, having regard to the state of scientific thought in his time, and his position as a naturalist.

As Sir Thomas Browne was born in 1605, and died in 1682, his life may be said to have been almost contemporaneous with the seventeenth century. As he spent forty-five years of his life in Norwich, his name must be invested with special interest to Norwich naturalists.

Though the fame of Sir Thomas Browne does not depend, except in a comparatively small degree, on his contributions to natural science, yet these alone, considering the period in which he lived, would have entitled him to the admiration of all lovers of nature, for the keen interest he displayed in animals and plants, and the pains he took to refute the errors existing about them. In these days of text-books and popular science, it is a somewhat difficult task to appreciate the position of a naturalist 250 years ago, without a brief survey of the state of knowledge at that time. Though John Ray was Brown's contemporary, Linnæus was still unborn, to shed light on the classification of plants and animals.

The animal and vegetable worlds have been so minutely mapped out for us, that it is hard now to understand the point of view of a period when specialism in science was so little developed, when natural science herself was looked on as more or less allied to

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magic and the dark arts, when Aristotle, Pliny, and Galen were the greatest authorities, on matters of biology (though this term is hardly a hundred years old) as well as on many other matters, when, in fact, the intellectual world may be said to have been dominated by Greek thought.

Not that Sir Thomas Browne relied too much on the authority of the ancients, as the following sentence from his 'Vulgar Errors' proves. "But the mortallest enemy unto knowledge, and that which hath done the greatest execution upon truth, hath been a peremptory adhesion unto authority; and more especially the establishing of our belief upon the dictates of antiquity" (Wilkin's [Bohn's] Edit. vol. i. p. 39). This sentence is the commencement of a chapter exposing this particular form of error, and shows the author to have been a man who brought a strong individuality to bear on the discussion of questions which came under his observation.

In trying to think ourselves, as it were, into Sir Thomas Browne's point of view, a very short outline of the history of natural science may assist us. Commencing with Aristotle, J. A. Thomson, in his 'Science of Life,' says:—"Aristotle was the first to draw that useful, but now somewhat hazy line between the back-boned and the backboneless animals. He knew about 500 different animals." This outline of classification of animals remained practically unaltered for eighteen centuries. No improvements of moment were made till the work of John Ray appeared in 1676. In botany, though a rather long line of botanists preceded Linnæus, to the latter we must look for the first serious and important work on the classification of plants. Sir Thomas Browne died before Linnæus was born, and can hardly be said to have been influenced by, or even to have come in contact with, much of John Ray's work, though some of Browne's observations were sent to, and utilized by Ray. Therefore, it seems, that in considering Sir Thomas Browne's own observations and studies, we must look on Aristotle as being the authority he would most naturally refer to, in matters of natural history, though, being a man of wide reading, he did not confine his references to Aristotle. We must not, however, overlook the fact that the sixteenth century had produced several important students of animal and vegetable life, such as Edward Wotton, Conrad Gesner, Aldrovand, Kaspar Bauhin, Cesalpino ('Science of

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Life,' pp. 3, 21, Thomson). P. Belon and G. Rondelet (Rondeletius), both living in the sixteenth century, remained standard authorities on Ichthyology for nearly a hundred years. Both, especially the latter, are frequently referred to by Browne. See 'Study of Fishes' (Günther). Harvey had discovered the circulation of the blood when Thomas Browne was still in his teens.

The Royal Society was incorporated in 1662, and in the list of members of the Council occurs John Evelyn's name. Evelyn was a friend of Browne's, and we find in his diary in 1671, he "went to see Sir T. Browne (with whom I had some time corresponded by letter, though I had never seen him before) his whole house and garden being a paradise and cabinet of rarities, and that of the best collections, especially medals, books, plants, and natural things. Amongst other curiosities, Sir T. had a collection of the eggs of all the fowl and birds he could procure, that county (especially the promontory of Norfolk) being frequented, as he said, by several kinds which seldom or never go farther into the land, as cranes, storks, eagles, and variety of water-fowl."

In one of his letters (Sloane MS. 1847, p. 182) Browne writing to a correspondent who had applied to him for information, regrets that he had not done so three years before as his assistants sometimes "fell upon animalls scarce to be met with agayne," adding "I had about fortie hanging up in my howse wch the plague being at the next doores the person intrusted in my howse, burnt or threw away."

The first work of Browne's, dealing partly with natural history, is the 'Pseudodoxia Epidemica,' published in 1646, now known as the 'Vulgar Errors.'

The 'Vulgar Errors' is an invaluable help to the student of scientific thought in the seventeenth century, but it would be out of place here to analyze it. Perhaps the word "common" would more nearly convey the meaning of his word "Epidemica" to our ears, than vulgar. Many of these "Errors" appear most extraordinary to us, but the student of folk-lore may still find, in out-of-the-way corners, some very curious beliefs or "conceits," as a Norfolk labourer would, and as Sir T. Browne did, call them. But the 'Vulgar Errors' was written for men of education, by one, and so affords a good index of the way in which natural phenomena were viewed at that period.

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In 1653—4 Sir Hamon le Strange, of Hunstanton, sent Browne eighty-five pages of MS. Observations of the 'Vulgar Errors' (preserved in Sloane MS.) (Dict. of Nat. Biog.).

The Third Book of 'Vulgar Errors' deals with "Popular and received tenets concerning animals." Many of these tenets seem to us to be too ridiculous to discuss, which may possibly, in the future, be the view taken by posterity of some of our present day discussions. However absurd some of the tenets appear to us now, we cannot help being struck with the interesting way in which Sir Thomas Browne discusses them, bringing all his erudition to bear on even the most insignificant, examining carefully the pros and cons of each.

For instance, in arguing about the existence of the Basilisk, which it was supposed by some, "poisoneth by the eye," he says that "this way a Basilisk may empoison" . . . . "is not a thing impossible." And his reason for thinking so is, "that the visible species of things strike not our senses immaterially, but streaming in corporeal rays, do carry with them the qualities of the object from which they flow, and the medium through which they pass." We have here very clearly put the old corpuscular theory of light, which was eventually superseded by the undulatory theory. From the amount of space devoted by Browne in his essays to the Basilisk, the Griffin, and the Phœnix, we are forced to conclude that these myths occupied an important position in the imaginations of people in those times.

On reading the account of Frogs, Toads, and Toad-stone, one cannot help being struck on finding that Browne believed in two separate modes of reproduction in the Frog. He had tried the experiment of incubating ordinary frog-spawn in a glass, and gives a fair account of the gradual development into the Tadpole, and finally into the Frog. At the same time, he held that the Common Frog and the Tree Frog arose from putrefaction, and that the first-named was called, specifically, *temporaria*, because it subsisted not long. We are not surprised to find that people believed then that Moles were blind, and that Lampreys had many eyes, but we now call these eyes bronchial apertures.

In arguing against the opinion that "the Chameleon lives only upon air," he endeavours to show the impossibility of any being existing upon air alone, and in his attempt to show this, he states

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that "the air so entereth the lungs, that by its nitrous spirit it doth affect the heart and several ways qualify the blood," going on with reasons against air being a source of nutrition to any animal. This curious belief in a nitrous spirit in the air is interesting, though its action on the blood in the way described is directly opposed to our notions of the action of respiration.

Of great interest to Norfolk Naturalists is Browne's "Account of Birds found in Norfolk." The earliest list of British Birds we possess is that in Merrett's 'Pinax Rerum Naturalium Britannicarum,' printed in London in 1666. It is little more than a bare catalogue and, as indicated by the remarks at the commencement of the first communication, it is evident that the "Account of the Birds found in Norfolk" was sent at Merrett's request, with a view to supplying information for a second edition of that work.

In the following list of animals, I have thought it sufficient to give the common name only, when there seemed to be no doubt in the case; but in other cases, to ensure certainty, I have quoted the modern scientific name, according to the authorities quoted at the end of the paper. I have used Vol. III. of Wilkin's [Bohn's] Edition in 3 vols. of Browne's Works, commencing with p. 311, and have, in nearly all cases, taken the names in the order in which they occur, to facilitate comparison. In exceptional cases, I have introduced quotations from the letters to Dr. Merrett. Mr. Southwell, who has lately copied the original MSS. at the British Museum, has kindly assisted me in cases where the reading seemed doubtful.

Birds.

The account consists of a list, with a few notes, of over eighty-five species of birds. On examining the list, we find the following common birds mentioned:

Teal.

Coot.

Moor-hen.

Water-rail.

Lapwing.

Cuckoo. Of which, he supposed, there were two sorts, probably owing to differences in age.

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KINGFISHER. Would that "that handsome coulered bird" abounded now as it did in Browne's days.

GOATSUCKER or Dor-hawk.

ROOK.

CROW.

HOODED CROW.

GROUND-LARK.

WOOD-LARK.

TIT-LARK.

STARLING.

GOLDFINCH, a kind of Anthus, a fools-coat.

The following birds are those which seemed to be less common, or about which there might be some uncertainty as to Sir T. Browne's naming.

Halyætus or FEN EAGLE. This is now generally called the White-tailed Eagle (*Haliætus albicilla*). A species of almost annual occurrence in autumn and winter, though always immature.

OSPREY. This is not asserted as being common in Browne's time.

KITE. Not in great numbers then around Norwich, owing, Browne thought, to the "plenty of Ravens about the city." "Now only an accidental visitant" (Stevenson).

GREY BUZZARD. Probably the common Buzzard. "No small number." Now "visits us annually in small numbers both in spring and autumn, but rarely in mature plumage" (Stevenson).

BALD BUZZARD. This is one of the names given by Pennant, as applied to the Osprey. Browne most probably refers to the Marsh Harrier or Moor Buzzard, which was very common in his time.

CRANE. "Often seen here in hard winters especially about the Champian and fieldie part." He mentions that at a dinner given by the Duke of Norfolk to the Mayor, Cranes were served. Stevenson says, "Whether the Crane ever bred* in Norfolk must remain an open question." Also, that "now it can be reckoned only as a rare and accidental visitant to this county."

ELK. "A name formerly used, but perhaps now obsolete, for the ordinary Wild or Whooper-Swan" (Newton). In hard winters "seen in no small numbers," and with his usual thoroughness he calls attention to the "strange recurvation of the wind-pipe

* See paper in present number of the 'Transactions,' p. 93.

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through the sternon," which, he remarks, is not to be found in the common Swans.

GANET. *Gannet.* One is alluded to as having been killed by a greyhound near Swaffham. These birds, under stress of weather, occasionally fly inland, in an exhausted condition.

Skua hoyeri. GREAT SKUA. Occasionally in hard winters.

Mergus major farrensis. GREAT NORTHERN DIVER. Pennant gives one name for this bird as *Mergus maximus farrensis, sive arcticus*, which evidently indicates the same species.

Pica marina, or Sea-pie. OYSTER-CATCHER. Only named as occurring, but must have been numerous in suitable localities.

LARI, SEA-MEWS and COBS. Many sorts. *Larus major* is spoken of as being in great abundance, in Herring time, about Yarmouth. It does not seem clear what bird is referred to here as *Larus major*. Cob is one of the local names of the Black-headed Gull.*

Larus alba or PUETS (so in the original). As this is referred to as breeding in great numbers about Horsey and at Scoulton Meres, the name, of course, refers to the Black-headed or Pewit Gull.

Larus cinereus, greater and smaller, commonly called STERNS. It seems difficult to identify these birds. Professor Newton states that Starn was formerly a common name in Norfolk for the Black Tern. There can be no greater and smaller Black Terns, nor are they likely to be referred to as "coarse meat."

Hirundo marina, or "SEA SWALLOW. A neat white and forked-tayle bird; but much longer than a Swallow." Evidently the common Tern.

Ciconia or STORK. Evidently rare in Browne's time, though two are mentioned as having been shot in the marshes between Norwich and Yarmouth.

Platea or SHOVELARD, SPOONBILL. "Wch build upon the tops of high trees." At Claxton and Reedham, and Trimley in Suffolk. Stevenson says, that "but for Sir T. Browne's record, it would scarcely be credited at the present time, that this remarkable species was formerly a resident in East Anglia." See Newton on

* The MS. says: "Many sorts of Lari, Sea-mews, and Cobs [then adds] the *Larus maior* in great abundance in herring time about Yarmouth." This evidently refers to one of the larger Gulls, it may be the Greater Black-backed or the Herring Gull.

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this subject, Vol. VI. p. 158 of our 'Transactions.' It is now an almost constant visitor in small flocks in spring and summer only.

Corvus marinus. Cormorant. Building at Reedham, upon trees from which King Charles I. was wont to be supplied. Still a fairly regular visitant to the county.

Rock Cormorant. Cometh to us in the winter. Probably the Shag, now rare on the Norfolk coast.

Shrewater. Manx Shearwater. First published in Willoughby's 'Ornithologia,' as made known to him by Sir T. Browne, who sent him a picture and an account of the bird (Newton). A rare bird off the Norfolk coast now.

Bernacles, Brants, are common. The Bernacle Goose is not common now, but the Brent Goose is "an abundant winter visitant to our coast" (Southwell).

Sheldrakes. *Sheledracus jonstoni.* Barganders (supposed to be a corruption of burrow-ganders) "wch breed in cunny burrows about norrold and other places." Mr. Stevenson in Vol. III. of 'Birds of Norfolk' gives an interesting account of the reasons why it is probable that these birds should have nested at Northwold (locally Norrold), or near there, which would be from forty to fifty miles from the sea, as now-a-days there is no locality known far from the sea in which this species breeds.

Wild Goose. *Anser ferus.*

Scotch Goose. *Anser scoticus.*

"Goshander." Merganser.

Mergus acutirostris speciosus or Loone. Great Crested Grebe. Here again Browne calls attention to an anatomical peculiarity found only in birds of this class. He says, "they have a peculiar formation in the leggebone wch hath a long & sharpe processe extending aboue the thigh bone."

Mergus acutirostris cinereus. This seems to be a variety of the Loon, as Pennant calls the Great Crested Grebe, the Ash-coloured Loon of Dr. Brown.

Mergus minor. Dabchick.

Mergus serratus. Red-breasted Merganser.

Mustela variegata. Probably *Mergus albellus*, or Smew. 'Birds of Norfolk,' vol. iii.

Anas platyrhinchos. Shoveller Duck.

Sea Pheasant. Pintail Duck.

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PELICAN. Shot upon Horsey Fen, May 22nd, 1663. "About the same time I heard one of the King's Pelicans was lost at St. James's, perhaps this might be the same." This needs no comment. See note on this species as a former inhabitant of Norfolk in last part of 'Transactions' (*ante* p. 363, vol. vi.)

Anas arctica clusii. PUFFIN.

Ardea stellaris, botaurus or *bitour*, is also common. BITTERN.

BUSTARD. Not infrequent. A melancholy interest is attached to this bird, as it is no longer an inhabitant of Norfolk.

Morinellus, or DOTTERELL. About Thetford.

SEA-DOTTERELL. Turnstone.

GODWYTS. From Browne's allusion to the daintiness and high price of these birds, agreeing with Pennant's statement, Stevenson considered this reference to allude to the Black-tailed Godwit. which, within the last century, has ceased to breed in Norfolk, It is now an irregular migrant only. The Yarwhelp, an old name for this Godwit, is mentioned separately by Browne, as if it were another bird, but his description does not quite apply.

GNATS or Knots.

Erythropus, or REDSHANK. "Common in the marshes, but no dayntie dish."

Avicula maialis, or MAY CHITT. From the description of this bird, there is no doubt that it was the Sanderling (Stevenson).

STINTS. "In great numbers about the sea-shore and marshes."

CHURRE. Probably "a full-sized Dunlin in one of its various stages of plumage" (Stevenson).

GREEN PLOVER. Lapwing.

GREY PLOVER.

Avis pugnans. RUFFE. Ruff. "Most abound in marshland, but are also in good number in the marshes between Norwich and Yarmouth." I fear this bird has ceased to breed here of late years. Browne noted the pugnacious character of the Ruffs towards each other. He may have observed what is now called "the play of ruffs," and considered it more pugnacious than it really is.

"Of *Picus martius*, or WOODSPECK, many kinds." Though *Picus martius* is the Linnean name for the Great Black Woodpecker, it was originally used as a more general term for all birds that climbed trees (Newton), and in that sense it appears to be used here, the individual species being enumerated below.

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GREEN WOODPECKER.

RED WOODPECKER. Probably Great Spotted Woodpecker.

Picus leucomelanus. Probably LESSER SPOTTED WOODPECKER. The hardness of the bill and skull, and the curious tongue of the Woodpeckers are alluded to.

Picus cinereus. NUTHATCH.

BLACK HERON. Browne's description of this bird, according to Stevenson, applies most nearly to the Purple Heron, an occasional visitor to this county, but the passage does not occur in the body of the MS. It is evidently a subsequent addition, and consists of a minute description of a bird, but there is nothing to indicate that it has reference to any local species.

HOBBY-BIRD. From the description, evidently the Wryneck. When the Hobby became scarce this bird was associated with another spring migrant, and became known as the "Cuckoo's Mate." "Maruellously subiet to the vertigo."

Upupa, or HOOPE-BIRD. Hoopoe.

RINGLESTONES. Ringed Plover. The derivation of Ringlestones is open to conjecture; but Professor Skeat thinks it may refer to the bird's habit of "ranging" (an old form of arranging) the stones for its nest" (Newton). Browne stated that he had been informed that the eggs were set upright in the sand or shingle, like eggs in salt. Stevenson thinks he was not far wrong in this, though Mr. Southwell's observations do not support it.

Arcuata or CURLEW. Curlew.

STONE-CURLEW. "Breeds about Thetford." This bird seems to have been first made known to British ornithologists by Browne, who about the year 1674 forwarded a drawing of it to the celebrated John Ray, taken from a specimen killed near Thetford (Stevenson).

Avoseta, called a Shoeing-horn. AVOCET.

Loxias or *Curvirostra.* CROSSBILL.

Coccothraustes. A kind of, called a Coble-bird, Hawfinch or Grosbeak.

BIRD-CATCHER. A kind of *Lanius.* Probably the Red-backed Shrike.

Avis trogloditica, or CHOCK. Wheatear (Stevenson).

RAVEN. "*Corvus maior.*" "In good plentie about the citty, wch makes so few kites to bee seen hereabouts." Never seen now in Norfolk.

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JACKDAW.

Ralla, or RAIL. Land-rail.

QUAIL. "No small number." Though still occasionally seen, not nearly so common as formerly.

"WHINNE-BIRD." "Lesser than a Wren." Also, less than the *Certhia*, or oxeye-creeper. In a letter to Dr. Merrett, he speaks of the "shining yellow spot on the back of the head [of the Whin-bird] is scarce to bee well imitated by a pensill." May we presume this to be the Golden-crested Wren?

Garrulus argentoratensis. THE ROLLER. This is the first record in Norfolk of this extremely rare visitant (Stevenson).

CHIPPER, or *Betulæ carptor*. "Cropping the first sprouting of the Birch trees, and comes early in the spring." Cheeper is a popular name for the Meadow Pipit, or Titlark. Mr. Southwell suggests the Siskin.

PARTRIDGE. "Though there bee here very great store of Partridges, yet the French Red-legged Partridge is not to bee met with." The introduction of the last-named species into the Eastern Counties dates from about 1770 (Stevenson).

One is, perhaps, surprised to find the Bearded Titmouse omitted from the "Account of Birds found in Norfolk," but Mr. J. H. Gurney in his paper on "The Bearded Titmouse" (Trans. Norfolk and Norwich Nat. Soc. vol. vi. p. 429) states that it was discovered by Browne, who through Ray brought it to notice in 1674. Neither Owls, nor the Nightingale, are alluded to as occurring in Norfolk.

In the letters to Dr. Merrett, we also find mentioned the Hobby, the Merlin, the former coming in the spring, the latter in the autumn. Also *Garrulus bohemicus*, the Waxwing.

FISHES.

In the "Account of Fishes, &c., found in Norfolk and on the Coast," many animals besides fishes are mentioned. Confining our attention first to the fishes, we find the following:—

Pristis serra,* or SAW-FISH. Dr. Lowe remarks that the occurrence of this species in Norfolk rests solely on Sir T. Browne's

* With his usual care for accuracy, he adds "comonly mistaken for a Sword-fish, and answers the figure in Rondeletius."

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authority (Trans. Norfolk and Norwich Nat. Soc. vol. i. 1873—4, p. 55).

SWORD-FISH. "Intangled in the Herring-nets at Yarmouth."

DOG-FISH. *Galei* and *caniculæ*.

Canis carcharius alter. "The seamen called this kind a Scrape." BASKING SHARK. (Dr. Lowe).

Sturio or STURGEON.

Mola or MOON-FISH. Generally known as *Orthagoriscus mola* or Sun fish. One taken at Mousley in 1667 weighing 200 pounds.

Rana piscatrix, or Frog-fish, *Lophius piscatorius*.

SEA WOLF or *Lupus marinus*. *Anarrhichas lupus*. Its remarkable teeth are alluded to.

Mustela marina, called by some a Weazel Ling. Probably the Five-bearded Rockling. Pennant calls the Rocklings Whistle-fish, but Yarrell gives reasons for holding that the name should be Weasel-fish.

Lumpus anglorum. LUMP-SUCKER.

Trachurus, or Horse. SCUD or HORSE MACKEREL.

Gornart cuculus. ROCHETS. RED GURNARD.

MULLET. Grey Mullet.

Mullus ruber asper. Also, in a letter to Dr. Merrett, *Mullus barbatus ruber mineaceus*, or *cinnaberinus*. Probably, both names refer to the Plain Red Mullet, or Surmullet.

Acus major or NEEDLE-FISH. GARFISH or GARPIKE.

Saurus. The SAURY PIKE or SKIPPER.

Scolopax or SEA WOODCOCK. This is probably *Centriscus scolopax*, or Trumpet-fish. Browne says that it was about three inches long, and was given him "by a seaman of these seas." Though a Mediterranean fish, it sometimes occurs on our southern coasts.

Acus, of Aristotle, or Addercock. DEEP-NOSED PIPE-FISH (*Syngnathus typhle*).

Piscis octangularis, of Wormius, or *Cataphractus*. The ARMED BULLHEAD or POGGE.

Faber marinus. The DORY or JOHN DORY.

Scorpius marinus. LONG-SPINED COTTUS or FATHER-LASHER.

STING-FISH or WIVER. From the dimensions given, Dr. Lowe thinks that the COMMON WEEVER (*Trachinus vipera*) is here referred to.

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Aphia cebites marina. The SPOTTED GOBY. Pennant. (*Aphya cobites* of Rondeletius.)

Belennus, a SEA-MILLER'S THUMB. Probably the SHORT-SPINED COTTUS (*Cottus scorpius*).

Funduli marini, SEA-GUDGEONS. Pennant gives Sea-gudgeon as a name for the Black Goby or Rock-fish, found on rocky parts of the British coasts.

Alosæ or CHADS. "To be met with about Lynne." Twaite or Allis Shad.

Spirinches or SMELT. Smelt "In greatest plentie about Lynne," where a small fish, called a "Primme" is considered by Browne as a young Smelt.

Aselli or COD, of several sorts.

Asellus albus or WHITING.

Asellus niger, carbonarius, or COAL-FISH. *Gadus virens* (Day).

Asellus minor. HADDOCK (*Gadus æglefinus*).

BASSE. BASS. *Labrax lupus* (Day).

Scombri or MACKEREL. Browne had doubts as to the good qualities of Mackerel as food, owing to the statement of Rondeletius, that they feed upon Sea-stars and Squalders. Day in 'British Fishes,' vol. i. p. 83, says: "Their food is a subject in which much remains to be investigated. Doubtless they prey upon members of the Herring family, and the fry of such forms as come in their way," and also, amongst other things, "upon a species of Jelly-fish at Mevagissey."

HERRING.

SPRATS or SARDÆ.

BLEAK or BLICÆ. *Alburnus lucidus.*

PILCHARD. "Though this sea aboundeth not with Pilchards, yet they are commonly taken among Herrings." Yarrell, quoting Couch, says "that the Pilchard is never seen in the Northern Ocean, and the few that sometimes wander through the Straits of Dover, or the British Channel, have evidently suffered from passing so far out of their accustomed limits" ('British Fishes,' vol. ii. p. 96).

CONGER.

SAND-EEL. Smoulds. LARGER LAUNCE (*Ammodytes lanceolatus*, Day.)

Pungitius marinus or SEA-BANSTICLE. ROUGH-TAILED STICKLEBACK (*Gasterosteus trachurus*, Day.)

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Pastinaca oxyrinchus. Sting Ray, or Trygon of the ancients (Pennant).

Raia clavata oxyrhynchus. Long-nosed Skate (*Raia oxyrinchus*, Day).

Raia oculata. Spotted Ray (*Raia maculata*, Day).

Raia aspera. Thornback Ray (*Raia clavata*, Day).

Raia spinosa. Cuckoo Ray or Sandy Ray. *Raia circularis* (Day).

Raia fullonica. Shagreen Ray.

Great Rhombus or Turbot. *Rhombus aculeatus.*

Rhombus levis. Brill (*Rhombus lævis*, Day).

Passer or Plaice. (*Pleuronectes platessa*, Day).

Butts. Flounders.

Passer squamosus. Dab (*Pleuronectes limanda*, Day).

Buglossus solea or Sole. *Solea vulgaris* (Day).

Lingula or Small Sole. *Solea lutea* (Day).

Salmon. "Salmon no comon fish in our rivers though many are taken in the Owse; in the Bure or North River; in the Waveney or South River; in the Norwich River, but seldome, and in the winter." Also, "Most of our Salmons have a recurved piece of flesh in the end of the lower jawe." A characteristic of the male fish, alluded to by Pennant, but Browne was not satisfied with this "conceit" which he was acquainted with.

Lucius or Pike. "Abound . . . of very large size." This statement is of some interest, as "considerable discussions have from time to time arisen as to whether the Pike is an acclimatized or indigenous fish in this country" (Day's 'British Fishes,' vol. ii. p. 140).

Brama or Bream.

Tinca or Tench.

Aulecula. Roach.

Rowds. Rudd.

Dare or Dace.

Perca or Perch.

Minnows. "Fewer than in many other rivers."

Trutta or Trout.

Trutta marina. Salmon Trout.

Aspredo perca minor. Ruff. "In great plenty in Norwich rivers."

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Lampetra. LAMPREYS. Great and small.

Mustela fluviatilis or EEL-POUT. BURBOT. *Lota vulgaris* (Day).

GUDGEONS or *Funduli fluviatiles.* Gudgeons.

Capitones fluviatilis or MILLER'S THUMBS.

Pungitius fluviatilis or STANTICLE. THREE-SPINED STICKLEBACK. *Gasterosteus aculeatus* (Day). STANSTICKLE in the Eastern Counties.

Aphia cobites fluviatilis or LOCHE. Loach.

COMMON EEL. Sharp-nosed Eel.

GLOT. Broad-nosed Eel. Day does not consider this to be a separate species.

Carpiones, CARP. "Plentiful in ponds." Günther in 'Study of Fishes' states "that 1614 is assigned as the date of first introduction of this fish into England," but Day remarks on its first mention "in Dame Juliana Berners' Boke of St. Albans, published in 1496" ('British Fishes'). Pennant speaks of the Carp having been "introduced here in 1514."

MAMMALIA.

Though the following Mammals are included in the "Account of Fishes," we must not suppose that Browne was ignorant of their distinct nature, as Aristotle had, long before, pointed this out. Up to Ray's time, one might say that all marine animals were considered as fishes.

SPERMACETI WHALE. Mr. Southwell states that the only recorded, though certainly not the only occurrences of this Whale on the Norfolk coast, are by Sir T. Browne. In a chapter in the 'Vulgar Errors' Browne explains the nature of spermaceti and ambergris.

GRAMPUS.

Tursio or PORPOISE.

DOLPHIN. "The Dolphin more rare [than the Porpoise] though sometimes taken wch many confound with the Porpoise." No instance of the occurrence of *D. delphis* on the Norfolk coast is known to naturalists of the present day.

Vitulus marinus, SEA-CALF or SEAL. *Phoca vitulina* (Linn.). One shot "about Surlingham Ferry."

OTTER.

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Mollusca.

Sepia. *Sepia officinalis.*

Loligo sleve or Calamar. Squid.

Oyster.

Mituli or Muscles. Mussels.

Chams or Cockles.

Pectines pectunculi varii. Lesser Scallop. *Pecten varius.*

Turbines or Smaller Wilks. Dog Whelk. *Nassa reticulata*, L. (Woodward).

Trochi, Trochili, or Sea-tops. *Trochus.* Top-shell.

Purpuræ minores. Purpura papillus.

Nerites. *Neritina fluviatilis*, probably.

Cochleæ. Cochlicella acuta, probably.

Tellinæ.

Patellæ. Limpets.

Solenes. Razor-fish.

Periwinkles, in plashes and standing waters. Species of Limnea.

Dentalia or Pin-patches. *Dentalium*, Tooth-shell.

Crustacea.

Lobster.

Astacus marinus pediculi marini facie. "Fore-claws about four inches long." Norway Lobster (*Nephrops*).

Crab.

Cancellus turbinum et neritis. Hermit Crab.

Balani. Acorn Barnacles.

Concha anatifera or Barnacle-shell. Goose Barnacle, *Lepas.*

Gammarus or Craw-fish. Cray-fish.

Scyllarus. Flat Lobster.

Echinodermata.

Echinus echinometrites. Sea Hedge-hog. Sea-urchin.

Stellæ marinæ or Sea-stars. Star-fish.

Stellæ marinæ testaceæ. Brittle-stars.

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Insects.

Pediculus marinus. Sea-louse.

Culex marinus or Sea-fly. Species of Gnat.

Gryllotalpa or Fen Cricket. Mole Cricket (*Gryllotalpa vulgaris*). "Now a rare insect in England.' 'Camb. Nat. History.' Insects. Dr. Sharp.

Hydrocantharus, Black Shining Water Beetle. *Dyticus marginalis.*

Forficula. Earwig.

Notonecton. Water Boatman. *Notonecta glauca.*

Scarabœus capricornus odoratus. "Taken abroad." *Aronia moschata,* L. Musk-beetle.

Musca tuliparum muscata. Tulip-fly. *Merodon narcissi,* probably.

Annelids.

Physsalus rondeletii. Sea Mouse.

Hirudines marini. Sea Leeches.

Horse Leech.

Vermes marini. Lug-worm (*Arenicola marina*).

Vermes in tubulis testacei. Serpulæ, or Tube-forming Worms (*Polychætæ*).

Tethys or Sea-dogs. Probably *Nephthys.*

Vermes setacei or Hard-worms. Hard is, evidently, a misprint for Hair. Hair-worm (*Gordius*). It was thought that horse-hairs could be converted into Hair-worms by laying them in water, which Browne tried, and, needless to say, did not succeed in doing.

Supplementary.

Urtica marina or Squalders. Jelly-fish.

Fibula marina crystallina. The description of this answers best to a Sea Anemone.

Lizards or Swifts. Newt.

Coral. This was supposed in Browne's time to be a *Lithophyton* or Stone Plant, and this belief continued for many years after Browne's death.

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In preparing the above list, I have derived much assistance from the following works:

'Birds of Norfolk.' Hy. Stevenson, F.L.S., and T. Southwell, F.Z.S., 3 vols., 1866, 1870, and 1890.

'Dictionary of Birds.' Prof. Newton, F.R.S., 4 parts.

'British Zoology.' Thos. Pennant, 4 vols., 1768.

Also some common names of birds from 'Our Country's Birds.' W. J. Gordon.

The 'Fishes of Great Britain and Ireland.' Francis Day, F.L.S., F.Z.S. 2 vols., 1880—1884.

'British Fishes.' Yarrell. 2 vols., 1836.

'Introduction to the Study of Fishes.' Günther, 1880.

'Insects.' Dr. Sharp, Cambridge Nat. History.

'Manual of the Mollusca.' S. P. Woodward, 1851—56.

'Worms, Rotifers, and Polyzoa.' Cambridge Nat. History.

I am also indebted to Mr. W. F. H. Blandford for kindly giving his opinion on some of the insects mentioned.

I had hoped to include in the preceding sketch an account of the Botany of Sir Thomas Browne, but the Zoology has involved so much time and labour that I must defer dealing with Sir Thomas Browne as a Botanist till a future period. Though well aware of the imperfections of this essay, I still venture to hope that it may possess some interest, as a slight contribution to local Natural History.

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X.

WILD-FOWL DRIVING IN THE SIXTEENTH CENTURY

By Thomas Southwell, F.Z.S., V.-P.

Read 27th March, 1900.

The most productive, if the most destructive and reprehensible method of taking wild-fowl was certainly that practised in certain parts of England long before the introduction of Decoys proper (which did not take place till early in the seventeenth century), and was known in the Lincolnshire and Norfolk Fens as "Ducking;" it is probable that the ruinous system here referred to, aided by the drainage works which had then been undertaken, had already greatly depleted the vast multitude of wild-fowl which bred in the Fens before the more reasonable method of decoying had been introduced to deal with the remnant which was left. Certain it is that most of the old writers mention this wasteful destruction and the vast numbers of moulting and young ducks which were annually destroyed by it, few of the authors, probably, speaking from personal knowledge, but apparently quoting each other without acknowledgment. Although this wholesale slaughter might be carried on with impunity in the seclusion of such a *terra incognita* as the Fens undoubtedly must have been in the reign of King John, or in 1432 when the mob stole 600 fowl from the Abbot's private waters at Crowland, the time was certain to come when an awakening would take place and the arm of the law be invoked, although, perhaps, at first not very successfully to put a stop to such practices, and this we find to have been the case.

In the papers belonging to the Spalding Gentleman's Society there is, according to Dr. Martin Perry, who has communicated it to the 'Fenland Notes and Queries' (vol. ii. p. 391), a curious note on this subject, which as it further illustrates my remarks in

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a former paper on Decoying (Trans. vol. ii. p. 538), I hope the Editor of that interesting journal will pardon my transcribing. It is as follows :—

DEEPING FEN DUCKING.—That is the Country People having Right of Common Enclosing many hundred acres wth large Netts having Pipes at their Ends & driving the Moulted Malards or Male Wild fowle into those Netts.

N.B. There are Very few ffemale or Ducks when They being with their Young ffeeding out at Sea, but the Drakes being sick or unable to fly their Wing Feathers being gone with Casting their Feathers Stay amongst the Reeds & Rushes in the broad Fresh Waters.

Spalding Elloe Holland in Lincolnsh — The Acc^t^ of fowle taken at the Ducking of several days in June 1728 by the people having right of Comon.

June y^e^ 20 = 394 doz^n^
21 = 387
24 = 305

Signed by Joseph Atkinson who was present & kept the Acc^t^ for the whol Company of Duckers.

Whereof — 155 dozen were taken y^e^ 1st day being Thursday the 20 June 1728 at One Push into the Netts.

By the Statutes 25 H. viii C xi. 1534 — The Cause of the decay of Wild Fowl is attributed to the taking them in the Summer Time & in their Moulting Season & therefore that is thereby prohibited to be done between the last day of May & the last day of August.—Spa* iiij^d^ for Each Fowl. [And one year's imprisonment.]

This was repealed at the Petition of the Fenn Men by 3 & 4 Ed. vi. c. vii. 1550 & It is hereby Sayd to have been found by Experience that there had been less plenty of Fowl brought to the Markets since that law had been made—and moreover It is sayd to have arisen in a private Cause, to have been of no comon comodity & in some sort branded as an Impious Law.

9 Ann C xxv. 1710 — The driving or taking Wild Fowl in ye Molting Season between 1st of July and 1st of Septr prohibited spa 5^d^ a ffowl.

This a Law for the better preservation of the Game & says in y^t^ season ye ffowl are Sick & their fflesh is Unsavoury & Unwholsom.

So far the communication in 'Fenland Notes and Queries' from the Spalding Society's archives, but it will be interesting to follow the further legislation on the subject to the present time.

* That is, sub pœna, under the penalty.

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It will be observed from the above interesting record that so late as the year 1728, in Deeping Fen the enormous number of 13,032 Ducks were driven in three days, and that 1,860 were secured by "one push into the nets!" and this notwithstanding the severe enactment of 1710 above quoted.

Sir Ralph Gallwey, in his 'Book of Duck Decoys,' explains the method by which the moulting drakes and "flappers," not fully able to fly, were driven by a vast number of men in boats, and armed with sticks with which they thrashed the reeds and water, into a vast horse-shoe shaped arrangement of nets ending in pipes similar to those in a Decoy, and he has reproduced a rare old print depicting the curious scene, so that I need say nothing more as to the method, but the fowl had not only to contend with these organised attacks, for in a communication to the Royal Society (published in 1696) giving "An Account of several Observables in Lincolnshire, not taken notice of in Camden or any other Author," Mr. Christopher Merrett, "Surveyor of the Port of Boston"* after mentioning the profits realised by the Duck, Mallard, and Teal, taken in the three Decoys at Wainfleet, the fowl from each of which he said were sent twice weekly between Michaelmas and Lady-day to London by men on horseback, many times forty or fifty dozen at once; he adds: "About Midsummer (when moultering time is) several Persons, some from Pleasure, others for Profit, go in small Boats among the Reeds, and with long Poles knock them down, they not being able to Swim or Fly from them." †

The Act of 25 H. VIII., c. 11 (1534), intituled, "An Acte agenst the Destruccyon of Wyld-fowle," sets forth that there had been plenty of wild-fowl, as Ducks, Mallards, Wigeons, Teals, Wild Geese, but that in consequence of divers persons inhabiting the districts where wild-fowl breed, having in the summer season, "at suche tyme as the seid olde fowle be mowted and not replenysshed with feathers to flye, nor the yonge fowle fully featherede perfyctly to flye, have, by certen nettes and other ingyns and polycies, yearly

* This was probably a son of Dr. Christopher Merrett, the author of the 'Pinax Rerum Britannicarum,' 1667, who states in the "Lectori Salutem" to that book that he had more than one son, and that the younger of them was named Christopher. Dr. Merrett died in 1695.

† Phil. Trans. 1696, vol. xix. p. 343.

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taken great nomber of the same fowle, in such wyse that the brode of wylde-foulle is almoste thereby wasted and consumed, and dayly is lyke more and more to wast and consume yf remedy be not therefore pvyded" * then follows the enactment as on p. 91. By this same Act the eggs of certain wild-fowl are also protected upon pain of imprisonment for one year, "and to lose and forfeit for every Egg of any Crane or Bustard so destroyed, purloined, withdrawn, or taken from any Nest or Place, Twenty-pence; and for every Egg of every Bittour, Heron, or Shovelard [*i.e.*, Spoonbill], Eight-pence; and for every Egg of every Mallard, Teal, or other Wild-fowl, One Penny," &c., "Provided always that this Act extend not, nor be hurtful at any Time hereafter, to any Person or Persons that shall destroy any Crows, Choughs, Ravens, and Bussards or their Eggs, or to any other Fowl or their Eggs not comestible nor used to be eaten." This scale of the penalties is very interesting, and may be taken in some degree to indicate the scarcity, or value in other respects of the species named, and the heavy penalty for taking the eggs of the Crane and the Bustard is particularly so.

Although there is no direct evidence of the breeding of the Crane in England, the inference derived from this and other similar mentions is very strong, and notwithstanding the vagaries of some of the local schedules of protected birds under the recent Bird Protection Acts, which will be sadly misleading to the Ornithologists of three centuries hence, it is hardly likely that in the sixteenth century so severe a penalty would have been enacted against the taking of the eggs of a bird which did not breed, or had not recently bred in the country. It will be noticed that although the Wigeon is named amongst the birds which must not be netted, it does not occur in the list of those whose eggs it is made penal to take, for the reason probably that "wiser than their successors" the framers of the Act knew it did not breed here, whereas all the others named in this section, including the Crane and the Spoonbill, doubtless did so.

But it will be observed that this wise regulation only remained in force for a brief period, arguments of a very specious character were brought against it, and in 1550 it was repealed (4 Ed. VI.); it was argued that the enactment was only obtained for private benefit, the market was starved, and that the Act was "taken to

* Folkard "The Wild-fowler" (3 Edit.) p. 23.

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come of the punishment of God, whose benefit was thereby taken away from the poor people that were wont to live by their skill in taking of the said fowl, whereby they were wont at that time to sustain themselves with their poor households, to the great saving of other kinds of victual, of which aid they are now destitute, to their great and extreme impoverishing." Thus although the taking of their eggs was still prohibited, the wild-fowl themselves were left unprotected, and we hear recorded by Willoughby, Latham, and others of the immense numbers taken.

This state of things seems to have continued till the year 1706, when an Act (5 and 6 Anne, c. 14) was passed, entitled, "An Act for the better Preservation of Game," the preamble of which is interesting, as it contains an enumeration of the class of "receivers" (against whom indeed the Act seems to have been mainly directed), and who at that time, and doubtless long after, gave the chief encouragement to the "idle loose persons" from whom the poachers were recruited. The words are: "Whereas several Laws have already been enacted for the better Preservation of the Game, and by Experience been found not sufficient to prevent destroying the Game, by reason of the multitude of Higlars and other Chapmen, which give great Encouragement to idle loose Persons to neglect their lawful Employment, to follow and destroy the same." By this Act it was also made penal for Higlars, Chapmen, Carriers, Inn-keepers, Victuallers, or Alehouse Keepers or other unlicensed persons to "keep or use any Greyhounds, Setting Dogs, *Hayes*, Lurchers, *Tunnells*, or any other engines to kill or destroy game." Although "Hayes" and "Tunnells" are mentioned amongst the destructive engines, this Act, which was only to be in force three years, was not specially directed against the evil practice of netting fowl, but it was in due course followed in 1710 (9 Anne, c. 25, section 4) by "An Act for making the Act of the Fifth Year of her Majesty's Reign for the better Preservation of the Game, Perpetual, and for making the same more effectual." This was specially directed against the netting of Fowl in the following terms:—"And whereas very great Numbers of Wild Fowl, of several kinds, are destroyed by the pernicious practice of driving and taking them with Hayes, Tunnels, and other Nets in the Fens, Lakes, and Broad Waters, where Fowl resort in the Moulting Time, and that at a Season of the Year when the Fowl

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are sick, and moulting their Feathers, and the Flesh unsavoury and unwholesome, to the Prejudice of those that buy them, and to the great Damage and Decay of the Breed of Wild Fowl. Be it therefore further enacted 'that between the 1st July and the 1st September' no person shall by Hayes, Tunnels, or other Nets, drive and take any Wild Duck, Teal, Widgeon, or any other Water Fowl in any of the Fens, Lakes, Broad Waters, or other Places of Resort for Wild Fowl," &c., under a penalty of 5/- for each Fowl, and not more than one month or less than fourteen days' imprisonment, with whipping, hard labour, and forfeiture of nets, &c., used.

In 1737, by the 10 George II., c. 32, this Act is confirmed with the following addition, "and whereas the said Act hath been found by Experience to be ineffectual, by reason that the Wild Fowl begin to moult before the 1st July and have not done moulting by the 1st September, so that great numbers of Wild Fowl are yearly destroyed contrary to the tone, intent, and meaning of the said Act;" therefore the close-time was ordered to commence on the first day of June and to continue to the first day of October. Penalty as before.

This Act remained in force till the year 1831, when by Section I. of the 1 and 2 of William IV., c. 32, entitled, "An Act to amend the Laws in England relative to Game," it, with 26 other Acts, relating to Game ranging from 13 Ric. II. to 59 Geo. III., c. 102, was repealed, but the taking of the eggs of "any Swan, Wild Duck, Teal, or Widgeon"* by "any person not having the right of killing the Game upon any Land nor having Permission from the Person having such Right" was prohibited, and this is apparently still the case, but I cannot find that there is any other Act protecting Ducks now in force except the modern Wild Birds Protection Acts.

* Why the eggs of the Wigeon are specially named here it is difficult to imagine, as this bird was certainly not known to nest in Britain until after that time.

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XI.

ON THE RAISING OF LYCOPODIUM FROM SPORES FIRST BY A NORWICH WEAVER.

By Thomas Southwell, F.Z.S., V.-P.

Read 27th March, 1900.

In an interesting letter containing biographical memoirs of several Norwich Botanists, written by Sir J. E. Smith to the Linnean Society,* dated Norwich, 14th January, 1804, and called forth by the death of his friend Mr. John Pitchford, whom he describes as "the last of a School of Botanists" in Norwich (that distinguished botanist being himself a Norwich man), refers to the great love for the cultivation of flowers which existed amongst the journeymen weavers and other persons in a humble sphere of life in that city, adding that there were amongst them others very distinct from mere florists who "herborised" in the country and made important additions to scientific botany, so that "in this town . . . . the writings and merits of Linnæus were, perhaps, more early, or at least more philosophically studied and appreciated, than in any part of Britain."

This letter was communicated to our Society in November, 1874, by the late Mr. Hampden Glasspoole, and was printed in its 'Transactions,' vol. ii. p. 25. It contains a statement that one "of these humble cultivators of science, Mr. Joseph Fox," was the first person who ever raised *Lycopodium* from seed. Sir James Smith had referred to this discovery in a previous communication to the Linnæan Society, and as the early volumes of the 'Transactions' of that Society are not very accessible, and it appears desirable more fully to record so interesting a fact in our local publication—more especially as it conveys a graceful compliment to an observer otherwise unknown to fame, the expression of which

* Trans. Linn. Soc. vol. vii. p. 295.

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does its writer infinite credit—I therefore append the original communication, which appears in the 'Transactions' of the Linnean Society, vol. ii. 1794, pp. 313—315, as an appendix to a letter from a Mr. John Lindsay to Sir Joseph Banks, dated June 30th, 1793, recording, the successful raising of *Lycopodium cernuum* and *Bryum cæspitithium*, "or a species very like it," from "some of the fine dust or farina" from their fructification, which he had "repeatedly sown from them both, and in a proper situation found they grew very readily." He, encouraged by this, sowed "that curious part of the fructification of *Marchantia polymorpha*" with equal success [p. 314]. The following are the

"ADDITIONAL REMARKS BY JAMES EDWARD SMITH, M.D., F.L.S."

"The foregoing observations of Mr. Lindsay are highly worthy of attention, as confirming the Hedwigian theory of fructification of mosses; and the result of his experiment on the *Bryum* was the same with those made on the same genus by Hedwig.

The raising of any species of *Lycopodium* from its farina has not, to my knowledge, been described as practicable; Mr. Lindsay [p. 315], therefore, has all the merit of an original observer. It is not to detract from his due praise, but to do justice to unostentatious ingenuity, that I now mention Joseph Fox, a journeyman weaver of Norwich, as having made similar experiments upon *Lycopodium selago* with the like success. He showed me, in the year 1779, young plants of this species raised from seed in his own garden. This humble observer, whose name has not yet appeared in any book, is the original discoverer of many rare plants in the County of Norfolk, and it is with pleasure I commemorate his former assistance to myself."

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XII.

OBITUARY NOTICES.

R. J. H. Gurney.

The annual revision of our list of members reminds us that

"The Leaves of Life keep falling one by one."

And in the past year we have lost one who had not nearly reached the period allotted by the Psalmist, as the span of human life.

Mr. R. J. H. Gurney, who died on the 6th of May, 1899, at the age of 44, had never enjoyed robust health, and was thus debarred from the active out-door pursuit of natural science, but had always been much interested in natural history. Mr. Gurney was a Fellow of the Zoological Society, and the success of the Norwich Castle-Museum, to which he had made several presents, was watched by him with great satisfaction; he was also a member of the Archæological Society, the archæology of his native county particularly claiming his attention. Mr. Richard Joseph Hanbury Gurney was the younger son of the late Mr. John Henry Gurney, and had married Sarah Evelyn, the fourth daughter of the late Sir E. N. Buxton, Bart. During his married life he resided principally at Northrepps Hall. He served the office of High Sheriff of Norfolk in 1896.

The love of animated nature may be traced through four generations of Mr. Gurney's family; his father was a distinguished ornithologist; his grandfather, Mr. Joseph John Gurney, if he did not make botany a study, yet knew much about plants, and appreciated their beauty; he has told in his diary that on one occasion especially, when fatigued and depressed with a long journey, he felt himself revived by the sight of wild-flowers growing by the road-side. He was one who had learned that

"The small flower
That twinkles through the meadow-grass, can serve
For subject of a lesson: aye, as well
As the most gorgeous growth of Indian climes;
For love of nature dwells not in the heart
Which seeks for things beyond our daily ken,
To bid it glow."

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We read also, in the biography of one of her daughters, that Mr. J. J. Gurney's mother, the wife of Mr. John Gurney, of Earlham, would take her children for country walks, and calling their attention to the beauties which surrounded them, try to instil into their minds a love of nature. Who can tell how great the debt which those descendants of this gifted lady, who have since been distinguished in the world of science, owe to these instructive rambles in the fields and lanes of Bramerton and Earlham. Perhaps as a society, anxious to contribute to the advancement of science, and justly proud of the papers which we have published, we have thought too little of the good we have been able to do by showing to what an extent a slight acquaintance with even one branch of natural history, may give interest to an otherwise uninteresting walk.

There are times when even a dullard must feel himself raised up to sympathy with nature, as when the singing of birds is heard, and all the trees of the wood rejoice, and re-awakening life leads our thoughts onward to summer sunshine and flowers and fruits, or again in the shortening days of autumn, when the falling leaves bring sadder thoughts, when we find

"Each fading calyx a *memento mori*,"

and muse on departed friends and buried hopes.

But the naturalist needs no inspiration to make his walks interesting; the common objects of the country; the birds, the flowers, the insects, and the stones, provide him with food for thought, with happy memories and pleasant anticipations; a knowledge of the life-history of the creatures he observes, adds enjoyment to his excursion. The earliest blossom of some tiny plant is to him as the greeting of a long-absent friend; the various indications of spring are noted by him with zest, and to chronicle the atmospheric changes is an agreeable occupation. Nor is it necessary to be a specialist to enter into these pleasures, the acquisition of a sufficient knowledge of biology is within the reach of all. What a happy bond of union with their parents when, as in the case of Mrs. Gurney, children are made companions in such walks, and truths are instilled into their minds through parables from nature!

Yet another illustration of the advantages of the study of natural

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history may be drawn from the family of our late member; his father, Mr. J. H. Gurney, suffered from a long and trying illness, a trial which was borne with great fortitude, and which was lightened to a great extent by his ability to continue the pursuit of his ornithological studies, in which it may be noted he had the assistance of his elder son, the present Mr. J. H. Gurney, and the sympathy of his younger son, the subject of this memoir.

W. H. B.

John Cordeaux.

In the death of Mr. John Cordeaux, practical ornithology has lost an earnest and capable worker, and general zoology, one of those "all-round" field-naturalists who are so fast disappearing before the modern specialist.

Mr. Cordeaux was born at Foston in Leicestershire, of which parish his father was Rector, on February 27th, 1831, and early in life circumstances led to his taking up his abode at Great Cotes, Lincolnshire, where he resided until his death, which took place somewhat suddenly on the 1st of August, 1899, in his sixty-ninth year. An active out-door life gave him a thorough acquaintance with the birds and beasts of his adopted county, and he developed that happy combination of sportsman and naturalist, so often met with in the rural districts, whilst in the latter years of what had been a very active life, his more abundant leisure was devoted entirely to his favourite study.

Mr. Cordeaux was elected a Member of our Society in 1876, and contributed to our 'Transactions' a valuable paper on the "Migration of the Stonechat" in 1877, also in 1878 a second paper entitled, "Some Recent Notes on the Avi-fauna of Lincolnshire." In 1872 he published the results of his long study of the ornithology of his neighbourhood in an admirable little book entitled, the 'Birds of the Humber District,' a supplement to which appeared just before his death; he contributed many papers to 'The Ibis,' 'Zoologist,' 'Naturalist,' 'Field,' and other similar journals, in some of which his descriptions of the peculiar features of the Lincolnshire Coast were very charming. In 1874 he paid his first visit to Herr Gätke in Heligoland, with whom he became a constant correspondent, and there is little doubt that the wonderful revelation he there witnessed, and his subsequent intimacy with

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Gätke, stimulated in him that keen interest in the subject of migration, which led to such important results, and he will be best known for the very energetic part he took in connection with Mr. Harvie-Brown in bringing about the appointment of a "Migration Committee" by the British Association, of which Committee he was appointed Hon. Secretary at the Swansea Meeting in 1880. It is not too much to say that the valuable investigations made by this Committee, extending over a period of nine years—the materials of which are not yet fully worked out—were due mainly to his untiring exertions—if that had constituted his only contribution to natural science, he ought, for that alone, to be held in remembrance by all Ornithologists.

Mr. Cordeaux did not confine himself entirely to ornithology, but was a recognised authority on the zoology and botany of his district, and the writer's first introduction to him, now many years ago, arose from their mutual interest in the Seals found in the Wash; nor was he negligent of the many social obligations which pertain to the position of a country gentleman and a Justice of the Peace.

Mr. Cordeaux was a Fellow of the Royal Geographical Society, a Member of the British Ornithologists' Union, and various other Societies, as well as of the Lincolnshire Naturalists' Union, of which he was President in 1894. By his personal friends his loss will be long sincerely regretted, and his death leaves a gap in the ranks of the school of practical naturalists which it will take long to fill.—T. S.

John Brooks Bridgman.

John Brooks Bridgman, a Vice-President, and an original member of our Society, died at Norwich on the 6th of October, 1899, at the age of 62. He was the son of William Kencely Bridgman, a man of varied acquirements in practical science, especially as a Naturalist and Microscopist, from whom the son doubtless inherited the taste for natural science, which developed itself early in his life. Bridgman was born at King's Lynn on the 9th of June, 1837, and, with his father, removed from that town to Norwich in 1842, where he in due time entered the Grammar School. Subsequently he studied dentistry, and after taking the degree of Licentiate of Dental Surgery, he assisted and eventually

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succeeded to his father's practice, which he continued to within a very short time of his death. The subject which first engaged his attention in the field of natural history appears to have been Conchology, and jointly with his father he made a very complete collection of the Land and Fresh-water Shells found in Norfolk, a list of which he contributed to our 'Transactions' in January, 1872, but the study of his mature life was the Parasitic Hymenoptera, in which branch of entomology he became one of the few recognised authorities, and was, perhaps, excelled by none. In 1873 he was elected Secretary of the Norwich Microscopical Society, a position which he held till the year 1884. In 1875 he was President of our Society, and devoted his Presidential Address to his favourite subject, "The Hymenoptera of the neighbourhood of Norwich." In 1883 he became a Fellow of the Linnean Society, and in 1886 of the Entomological Society of London, to the 'Transactions' of which he contributed a series of papers extending over the years 1881—86, consisting of "Additions to Mr. Marshall's Catalogue of the British Ichneumons," in which he chronicled a great number of British species new to science. He also, in connection with Mr. E. A. Fitch in the 'Entomologist' (to use the words of a writer in the 'Entomologists' Monthly Magazine'), gave a "masterly" series of "Introductory papers" on the Ichnomonidæ, which were discontinued, incomplete, in 1885, but "must form the foundation upon which to work the British species." Bridgman's contributions to our 'Transactions' numbered seventeen in all, the most important of which were the list of the Land and Fresh-water Shells already mentioned; a list of the Aculeate-Hymenoptera of Norfolk, in 1876, with continuations in 1881 and 1889; of Sawflies, in 1887; and a list of the Ichneumons found in Norfolk, in 1893. A full list of Bridgman's contributions to Entomology, for which I am indebted to Mr. Claude Morley, will be found appended. In the year 1895, to the great regret of his friends and numerous correspondents, chiefly owing to failing eyesight, he was compelled to discontinue the study of this branch of entomology, and generously presented his whole collection, with about forty volumes of books and MSS. (which number was increased after his death by Mrs. Bridgman), to the Norwich Castle-Museum. The collection is arranged in two cabinets of twelve and fourteen drawers respectively, and with regard to it

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Mr. Claude Morley (before quoted) says that it is "a marvellous collection for one man to compile, and is especially complete in the determination of species," . . . . "the Ichneumons represent, if not the most numerous, at all events the best arranged and most fully-named collection in Britain, speaking eloquently of hours of close and untiring study."

But it was not alone as a Naturalist that Bridgman took a prominent position; he was greatly distinguished as a Freemason, and the founder of a Lodge named after himself; he was an Hon. Major of Volunteers, for two years the Champion Shot of the County, and was one of the first Officers to receive the Long Service Decoration. Of late years he was troubled with a bronchial affection, and finding relief from the sea-air, turned his attention to sea-fishing, in which he soon excelled, as in most other things; in fact, the distinguishing features in all he undertook were his thoroughness and the generous spirit in which he gave others the benefit of his experience and researches.—T. S.

List of Papers by the late J. B. Bridgman, F.L.S.

Some additions to Mr. Marshall's Catalogue of British Ichneumonidæ—Trans. Ent. Soc. Lond. 1881, pp. 143—168 (with plate); 1882, pp. 141—164; 1883, pp. 139—171; 1884, pp. 421—433; 1886, pp. 335-373; 1887, pp. 361—379; 1889, pp. 409—439.

"Introductory Papers on Ichneumonidæ" (with E. A. Fitch, F.L.S.)—'The Entomologist,' vol. xiii. pp. 25, 97, 179, 210, 247, 297; xiv. pp. 58, 77, 109, 129, 205; xv. pp. 11, 78, 180, 222, 275; xvi. pp. 33, 100, 155, 225; xvii. pp. 121, 176, 223; xviii. pp. 13, 100, 205. (The series was not completed.)

"Mesostenus obnoxius," *lib. cit.* xiii. p. 18; "Notes on Hymenoptera," *l.c.* p. 51; "Vanessa Antiopa in Norfolk," *l.c.* p. 240; "Three new Ichneumons," *l.c.* p. 263; "Captures of Aculeate Hymenoptera," *l.c.* xiv. p. 238; "Ichneumon erythraevs," *l.c.* xv. 139; "Hymenoptera in Norfolk," *l.c.* p. 238; "Notes on the genus Hemimachus, Ratz," *l.c.* xvi. p. 49; "Pimpla spuria, Gr.?" *l.c.* p. 251; "Ichneumons and their Hosts," *l.c.* xvii. p. 69.

"Glypta cicatricosa, R., G. flavipes, D., ♀, and G. rubicunda, n. sp., New to Britain," EMM. 2nd series, vol. i. p. 208.

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The Lists of "Mollusca" and "Hymenoptera" in Mason's 'History of Norfolk.'

Sir James Paget, Bart.

Sir James Paget, Bart., who was elected an Honorary Member of our Society in 1892, was born at Great Yarmouth on the 11th of January, 1814, and died in London on the 30th of December, 1899. Brought up to the medical profession, he studied first under Mr. Charles Costerton, a well-known Surgeon at Yarmouth, whence he proceeded to St. Bartholomew's Hospital and passed the College of Surgeons in 1836, soon obtaining great distinction in his chosen profession. His elder brother, Sir George Paget, K.C.B., became almost equally distinguished in the sister branch of medicine, being appointed Regius Professor of Physic in the University of Cambridge.

It was in early life that Paget distinguished himself as a naturalist, doubtless the result, in a great measure, of his association with Dawson Turner, C. S. Girdlestone, Richard Lubbock, and others, who formed a remarkable group of Field Naturalists at a time when such pursuits were generally regarded with little favour, and he was ably seconded by his brother Charles John, who died in 1844 at the early age of 32. Together they

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produced an admirable little book entitled, a 'Sketch of the Natural History of Yarmouth,' which was published in 1834. This early record of the energy and research of the two brothers was certainly one of the first and most complete of the local Faunas, which of late years have become so popular, and even in the present day, beyond the numerous additions which modern research has made, his observations are absolutely reliable and of the greatest value. Many notices of Norfolk Naturalists, contemporary with the Pagets, and working in the same line, will be found in the second volume of our 'Transactions.'

Sir James never forgot that he was a Norfolk man, and always took a lively interest in all that concerned his native town and county; his busy professional life in London rendered it impossible for him to indulge in the pursuit of natural science with the vigour he displayed in early life, but he was always ready to assist with his influence and ripe experience those who in this respect were more fortunately situated than himself, as evinced by the interest he expressed in our Yarmouth section, and his presentation to our Museum in 1885 of the Herbarium, which he formed when compiling the botanical section of the Natural History of Yarmouth. In him the Society has to regret the loss of one of its most distinguished members.

Among the numerous honours showered upon Paget was a Baronetcy in 1871 in acknowledgment of his eminent services rendered to surgery; in 1875 he was made President of the College of Surgeons; in 1877 he became Sergeant-Surgeon to the Queen; in 1881 he was chosen President of the International Medical Congress; in 1884 he was made Vice-Chancellor of the University of London, added to which honorary degrees and distinctions were heaped upon him both at home and abroad.—T. S.

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XIII.

BRITISH ASSOCIATION MEETING AT DOVER.

By J. T. Hotblack, *President.*

Read 26th September, 1899.

As your delegate I went to Dover to attend the meeting of the British Association. Having arranged for apartments beforehand, for they were very scarce, and ridiculously dear (in fact, Dover is not big enough to accommodate so large a body as the British Association with ease or comfort), I arrived on the Wednesday, mid-day, thinking to have time to look about me, for though no stranger to Dover, the attending a meeting like that of the British Association was quite new to me.

I went at once to the reception room, where I saw a ground plan of the hall, for the presidential address, like that we have for securing numbered seats at the Festival, but to my dismay every seat (except two or three at the very back of the gallery) was taken, but when I complained to the clerk in charge of the inability of one, arriving, as I thought, in very good time to secure a decent seat, he, noticing my ticket stamped "General Committee," said, "You, at all events, are all right, for there are several rows in the very front of the hall reserved for the Committee."

The evening meeting was a very brilliant affair, every one in evening dress, almost as many ladies as gentlemen, and many of the latter wearing orders and decorations, English and foreign. Thanks to my position on the Committee as your delegate, I had a very good seat.

Sir Michael Foster's presidential address (after paying the usual tribute to the memory of eminent members deceased since the last meeting) was practically a review of the progress of science during the 19th century, though he was careful to explain that the century does not close with this year, but with next. The retiring President, in introducing Sir Michael Foster, commenced by referring to the ancient importance of Dover, remarking that William the Conqueror

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called it the lock and key of England, and ended by saying that his hearers had not come to listen to the rumblings of a nearly extinct volcano, and so he would say no more.

Sir Michael's address has already been read by, I was going to say most people, and I will not trouble you with any of it except to remark that I thought he made one or two good hits, in one where he called science organised common-sense, and in another when he said, the very perfectness of the present implements of war make for peace.

On the Thursday morning I attended the geological section, under the presidentship of Sir Archibald Geikie, when Professor W. Boyd Dawkins read a paper on "The New Coal Borings in Kent," which was illustrated by very complete diagrams. The substance of what he said was, I think, that at Dover commencing in the lower chalk, after about 1,300 feet, they came to the coal measures, of which they had already penetrated 700 feet, passing through in that distance various seams of coal of an aggregate thickness of 13 feet, but of which only two or three are of workable thickness, the thickest being but 2½ feet, the whole of the workable coal being of "good blazing quality," which, I take it, means that it is not very good. Of course, the hope is that the better and thicker seams are below, and that they will soon be reached.

From the Professor's paper one would conclude that the success of coal-mining in Kent is a certainty; but, alas! when one enquired as to the value of the shares in the several undertakings for the finding of coal in Kent, they seemed to tell a very different tale. I think, however, that the Professor made it clear that the coal-field, of whatever quality it may prove to be, will not be a very large one, and that it will not extend at all to the west of the railway line from Folkestone to Ashford and Maidstone—one reason, among many others, being, that at Tunbridge Wells the coal measures have been proved to be absent.

On the Thursday afternoon I attended the first of the Conferences of Delegates of Corresponding Societies, as your representative. We had a most witty and interesting paper by the Chairman, the Rev. T. R. R. Stebbings, F.R.S., on "Underground Fauna," in which he described the various wonderful things that come under this definition in foreign countries, including those extraordinary blind fishes in America. But it seems there is not much hope of finding much besides the Well-Shrimps in this county that properly

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belongs to the underground fauna. I was able to say that we had already had specimens of the Well-Shrimp brought to our notice by our member, Dr. Harmer, of Cambridge.

In moving or seconding a vote of thanks, I expressed a hope that the pruning-knife should not be used on the paper before publication, so as to take out all the author's charming banter, but that, if possible, it should be published *in extenso*. This was evidently the general feeling of the meeting, and it was carried accordingly.

On Thursday afternoon there was a very charming Garden Party in the College Grounds, where, among other attractions, the preparations for a balloon ascent could be watched without the usual crowding.

On Thursday evening the Mayor, Sir W. H. Crundall, gave a conversazione at the Town Hall, which was a very grand affair. The building had been most elegantly arranged. There was plenty of music; and messages were sent, or supposed to be sent, across the Channel to France by the wireless telegraphy, the arrangement of the wire, carried to the top of a light and not very lofty flag-staff for connection with the atmosphere, seemed to be extremely simple; but the transmitter was a very powerful battery, making a very large spark at each impact; and the receiver was, to my mind, not working satisfactorily, in fact, during the several times I looked at them I could not be quite sure that they were really sending or receiving messages at all, though they were distributing slips printed in the Morse alphabet.

On Friday morning I again attended the geological section, when some most beautiful photographs of minute fossils from the chalk were shown by means of a lantern. They were by Dr. A. W. Rose.

Then there were two papers by Dr. G. Abbott, who laboured to show that flint might have been formed in the chalk after the latter was raised above sea-level by the infiltration of fresh water, but I do not think very successfully. Then we had two papers on "Glaciation in East Anglesea." Then a very good paper on "Extra-Morainic Drainage in Yorkshire," showing what the ice-melting did there, illustrated by a large number of photos shown by the lantern, many of them beautifully done. This was by Mr. P. F. Kendall.

Then another good paper by Mr. J. Lomas on "Lateral Moraines and Rock Trains," also illustrated by good photos shown by the

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lantern; but in the discussion after the paper I was properly snubbed for asking if the Rock Trains moved at the same rate as the glaciers, and if Mark Twain's account of the rate of travel of the latter was correct. I was referred to the text-books, which, seeing nearly all we had heard during the morning was to show that the text-books were wrong, was not very satisfactory.

But the best paper, to my mind, was the next, by Professor W. J. Sollas, on the "Origin of Flint," and I think he satisfactorily proved that flint was formed at some little depth below the surface of the chalk deposit at the time, and by the dissolving of the silica out of the fossil sponges contained in it.

After this paper I left, went to luncheon well tired of listening, and in the afternoon joined an excursion to Deal Castle, the residence of Lord George Hamilton, and which is, I believe, held by virtue of the sinecure office of "Captain of Deal Castle." There is now no garrison, and the part facing the sea has been converted into a dwelling-house, where, I believe, Lord George resides when not in London.

But there is a very great deal of the original work left, which is interesting as late and debased Tudor. The moat is all but perfect, and the places where the drawbridge swung and the portcullis hung are plainly seen; in fact, except for the front next the sea, the whole place is much as it was when besieged by Cromwell's soldiers; the print of one of their cannon-shot is shown in the main door.

On Saturday morning I again attended the geological section to hear the Sectional President's Address. Sir Archibald Geikie took for his theme the question of "Geological Time," and arrived at the conclusion that this world of ours is something between twenty millions and one hundred millions of years old.

On Tuesday the second of the delegates' meetings was to be held, when the subject of discussion was to be the preservation of national places of interest. I suspect this would be more archæological than anything else, and had I been a delegate of the Archæological Society instead of your own I think I should have felt it my duty to attend. But as it was, a proposed visit to the Dover coal boring, I think, would have had a too irresistible attraction to me. But, alas! when I returned from the Saturday morning's address I found telegrams which necessitated my immediate return home, and so my too brief holiday in your service came to an end.

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XIV.

NORFOLK GALLS.

(Communicated by the Rev. E. N. Bloomfield.)

No list of galls or gall-makers has been published by our Society. It may be well, therefore, to give a list of a few galls or pseudo-galls met with by my friend Mr. E. Connold, of St. Leonard's, while staying at Aylsham in July, 1899. July is not a good month for galls, being too late for the early galls and too early for those of autumn. Galls of the following species were observed, most of which are of general distribution, but a few are decidedly worthy of note:—

CYNIPIDÆ.

AULAX GLECHOMÆ. Green, or green with red hairy galls on the leaves of the Ground Ivy, *Glechoma hederacea*.

AULAX HYPOCHÆRIDIS. Spindle-shaped swellings on the flower peduncles of the Long-rooted Cat's-ear, *Hypochæris radicata*. Cromer.

AULAX PAPAVERIS. Galls in the seed vessels of the Corn Poppies, *Papaver rhœas* and *P. dubium*, generally more or less distorting them.

DIASTROPHUS RUBI. Spindle-shaped swellings on the stems of Brambles, *Rubus fruticosus*, &c.

The following species all occur on the Oak:—

ANDRICUS INFLATOR. Swells the ends of the twigs of Oak, which thus become thickened and shortened. In this the gall is concealed.

ANDRICUS CURVATOR. Bladder-like swellings on the leaves, containing an inner gall.

ANDRICUS RADICIS. Polythalamous galls, often very large, at the root or on the trunk near the ground.

ANDRICUS SIEBOLDII. Gregarious galls on the small branches of young Oaks; when young reddish and viscid, when old striated and woody.

TERAS TERMINALIS. The well-known *Oak Apple*. Soft spongy swellings at the ends of the shoots.

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CYNIPS KOLLARI. The marble gall. Hard round galls attached to the shoots.

DRYOPHANTA DIVISA. Berry-like galls on the underside of the leaves.

NEUROTERUS LENTICULARIS. The Common Spangle Gall.

The following galls, or pseudo-galls, are formed by

CHALCIDIDÆ.

EURYTOMA HYALIPENNIS. Swollen imbricated buds on the Marram Grass, *Psamma arenaria*. Cromer.

CECIDOMYIDÆ.

CECIDOMYIA CRATÆGI. Causes rosettes of leaves at the ends of the shoots of Hawthorn, *Cratægus oxyacantha*.

CECIDOMYIA BURSARIA. Tubular galls on the leaves of Ground Ivy; they often drop out, leaving circular holes in the leaves.

CECIDOMYIA ROSARIA. Rose-like tufts at the ends of the branches of Sallows.

CECIDOMYIA MARGINEM-TORQUENS. Rolls and thickens the margins of the leaves of the Long-leaved Willow, *Salix viminalis*.

CECIDOMYIA ULMARIÆ. Small galls on leaves of Meadow Sweet, *Spiræa ulmaria*.

CECIDOMYIA URTICÆ. Small hairy galls on the stem or leaf of the Common Nettle.

DIPLOSIS BOTULARIÆ. Bladder-like swellings on the mid-rib of the leaves of Ash.

DIPLOSIS LOTI. Deforms the flowers of the Crowfoot, *Lotus corniculatus*.

LASIOPTERA RUBI. Causes swellings on the stems of the Blackberry.

TENTHREDINIDÆ (SAWFLIES).

NEMATUS GALLICOLA. Red bean-like swellings on the leaves of Willows.

APHIDES.

CHERMES ABIETIS. Cone-like polythalamous galls on the Spruce Fir, *Abies excelsa*.

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PEMPHIGUS BURSARIUS. Purse-like galls on the foot-stalks of the leaves of Poplars.

SCHIZONEURA ULMI. Causes the leaf of the Elm to swell, turn pale, and curve.

Other galls formed by *Phytopti*, or of which the maker was unknown, were also found, but the above may suffice for a first list.

All the above galls, for which no locality is given, were found in or near Aylsham.

Since writing the above list I have received from Mundesley the small "blister like" galls of CECIDOMYIA GALII on the Yellow Bedstraw, *Galium verum*.

XV.

MISCELLANEOUS NOTES AND OBSERVATIONS.

A PLEA FOR THE HOUSE SPARROW.—Amongst the many delinquencies of the Sparrow—and they are many—it is alleged that it does no good to the farmer; but this is, I think, a mistake. Mr. Gurney, in his pamphlet 'On the Misdeeds of the House Sparrow' (*Passer domesticus*), published in 1887, ably and for the most part accurately stating the case *pro* and *con*; says p. 3: "Can any one else, who wishes to speak on behalf of the Sparrows, produce any evidence of their feeding—not occasionally but habitually—in any locality in the United Kingdom, on the Wireworm or on the Larva of the Gamma Moth or Cranefly?" Although 'One Swallow does not make a summer,' and although a single instance may not come under Mr. Gurney's heading of 'habitually feeding' on Wireworms—there is, I think, sufficient evidence that the enquiry was altogether inadequate to settle this point, and that a more minute and different mode of enquiry is needed.

It is now very many years since, during my boyhood, I was examining a nest of young Sparrows in a spout, and was astonished to find in the nest some thirty or forty Wireworms of varying sizes. They had evidently been brought to feed the young birds, and had been dropped in the process. They had been clearly obtained from an adjoining garden which had been recently dug

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over. There was certainly no evidence of the Larva of the Gamma Moth, or the Cranefly being brought for food, but there is no evidence to show that either of them are other than distasteful to the bird, which would not be the case with the Wireworm, which would closely resemble the Mealworm in appearance, and probably in wholesomeness. I think this kind of examination is well worth repeating, but it should be done with care. If any Wireworms are found in a nest, it should be carefully examined to the bottom, as many of the Wireworms creep through the nest. I am fully aware of the destructive habits of the House Sparrow, especially as regards the Crocus. The yellow flowers of this are especially attractive to the birds, but the purple kind are not much hurt. The birds only pick out the yellow stamens and pistils.

I saw some years ago a marked instance of the affection of this bird for its young. At the back of my house in London was the chimney of a mews in which a pair of Sparrows had built and hatched their young. The chimney had long been disused, but one day a fire was lighted in it, and volumes of black smoke issued from it. The poor birds were terribly distressed at this result, but the στοργή was so strong that they made most vigorous efforts to go to the young ones. Flying into the dense smoke, they remained in it until, driven away again and again by the suffocating fumes, they had to retire on to the roof for a breathing space, panting and gasping for breath. It was wonderful to see the tenacity with which the efforts were renewed, until at last the poor young ones were suffocated by the smoke.—JOHN LOWE, M.D.

GREAT BUSTARD.—The following mention of a Bustard which may have been of Norfolk origin occurs in "Memoirs of the Vernon Family . . . . compiled from the Letters . . . . at Claydon House by Margaret M. Verney. Vol. iv. London, 1899." p. 188.

"March 16, 1675."

"There is much eating and drinking in Mun's correspondence. Dr. Denton has a picturesque banquet. 'All ye gang was here last night drinking Sir Ralph's health, and preying on a goodly formidable beast out of ye Fens called a Bustard, wch was more than a whole round table & bystanders could devour. When will 'Barley yard or Knowle Hill produce such a Beast?'"

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It is not explicitly stated by the Editor (Lady Verney) who the writer of this passage was, but this style is that of "Mun"—*i.e.*, Edmund Verney, son and heir to Sir Ralph Verney, the first baronet, who predeceased his father in 1688; nor is it at all clear where Dr. Denton's dinner or supper was given; but apparently at Newmarket, where Edmund Verney seems to have stayed several times for the racing, though it may have been at Hillesden in Bucks, where Dr. D. ordinarily (?) lived (he died in 1691) (p. 458) when in the country. He was Edmund Verney's uncle (p. 284). "Barley Yard" and "Knowle Hill" seem to have been properties (farms or manors) of the Verneys, somewhere in Bucks.—A. NEWTON.

CROWNING OF JACKS.—In February, 1884, I read a paper before the Society on "The Fens and Fen-folk,"* in which I quoted a passage from Fen Bill Hall descriptive of the summer's occupations of a Fen-man; amongst numerous other operations pertaining to his calling he mentions the "Crowning of Jacks," evidently referring to some method of capturing these fish, but what that method was I was unable to explain, and although Mr. Cordeaux was kind enough to insert a query in the 'Lincolnshire Notes and Queries,' he was not successful in gaining any enlightenment. Quite recently I came across a passage in Pennant's 'British Zoology' (8vo. Edit. 1769, vol. iii. p. 272) which seems to afford the desired explanation; it is as follows:—

"In the shallow waters of the Lincolnshire Fens they [*i.e.* Pike] are frequently taken in a manner peculiar, we believe, to that county, and the Isle of Ceylon.† The fisherman makes use of what is called a crown-net, which is no more than a hemispherical basket open at top and bottom. He stands at one end of the little fen-boats, and frequently puts his basket down to the bottom of the water, then poking a stick into it, discovers whether he has any booty by the striking of the fish; and vast numbers of Pike are taken in this manner." The net appears to have been similar to the bow-net used in the Broads for taking Tench, which seems to be much more suitable for the latter fish than for Pike; but it is possible that there may have been some peculiarity in the construction of the "crown-net" which Pennant has not particularised.—T. SOUTHWELL.

* Trans. Norfolk and Norwich Nat. Soc. vol. iii. p. 625.

† (Foot-note in original) "Knox Hill, Celon, 28."

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The Society consists of two classes of Members, viz., Ordinary and Honorary Members.

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Ladies or Gentlemen distinguished for their attainments in Natural Science, or who have rendered valuable services to the Society, may be nominated by the General Committee as Honorary Members, and elected by a show of hands at the next meeting of the Society. Such Honorary Members have all the privileges of Ordinary Members.

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OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY;

PRESENTED TO THE MEMBERS FOR

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1. The Practical Study of Natural Science.

2. The protection, by its influence with landowners and others, of indigenous species requiring protection, and the circulation of information which may dispel prejudices leading to their destruction.

3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.

4. The record of facts and traditions connected with the habits, distribution, and former abundance or otherwise of animals and plants which have become extinct in the County; and the use of all legitimate means to prevent the extermination of existing species, more especially those known to be diminishing in numbers.

5. The publication of Papers on Natural History, contributed to the Society, especially such as relate to the County of Norfolk.

6. The facilitating a friendly intercourse between local Naturalists, by means of Meetings for the reading and discussion of papers and for the exhibition of specimens, supplemented by Field-meetings and Excursions, with a view to extend the study of Natural Science on a sound and systematic basis.

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Year ending March, 1901.

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To Balance from last year	10	18	11	By Fletcher and Son, Limited, *Transactions*, 1899—1900	32	10	0
To Subscriptions: —				,, Sundry Printing and Stationery	5	12	11
£ s. d.				,, A. H. Goose, Printing, Stationery, and Postage ...	1	3	6
3 ,, 1897—98 ... ... 0 15 0				,, Postage, &c.	4	2	1
5 ,, 1898—99 ... ... 1 5 0				,, Expenses of Meetings	2	1	0
13 ,, 1899—1900 ... ... 3 5 0				,, Insurance	0	9	0
154 ,, 1900—1 ... ... 38 10 0				,, W. Haydon, bookbinding	2	19	3
12 ,, 1901—2 ... ... 3 0 0				,, Use of Room at N. & N. Library	1	1	0
46 15 0				,, Lynn Museum	2	2	0
,, Additional payments	0	13	0	,, Assistant Secretary's Salary	5	0	0
,, Sale of *Transactions*	2	4	5	,, Balance at Messrs. Barclay's Bank	13	10	7
,, Transferred from Life Membership Fund	10	0	0				
£70	11	4		£70	11	4	

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£110	16	8		£110	16	8	

Norwich, 26*th March*, 1901.

Examined with vouchers and found correct,

STEPHEN WM. UTTING, *Auditor.*

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ALGA-FLORA of Yorkshire. A complete account of the Fresh-water Algæ of the County, by W. West, F.L.S., and G. S. West, B.A., A.R.C.S. 1st and 2nd Instalments. Leeds, 1900.
From Yorkshire Naturalists' Union.

ANDERSONIAN Naturalists' Society Annals. Part 1. Vol. ii. 1896, Glasgow.

ANNALES de la Société Belge de Microscopie. Tome xxv. Bruxelles, 1899. Bulletin, Mar. 1900. *From the Society.*

AUK (The). Vols. 1—10. 1884—1893.
From Mr. J. H. Gurney, F.Z.S.

BARROW Naturalists' Field Club. Annual Report. Vol. xiv. Kendal, 1900. *From the Club.*

BATH Natural History and Antiquarian Field Club, Proceedings of the. Vol. ix. no. 3. 1900. *From the Club.*

BELFAST Naturalists' Field Club. Annual Report, 1898—99. Belfast, 1900. *From the Club.*

BIRDS, Hand List of. Vol. ii. R. Bowdler Sharpe, LL.D. London, 1900. *Presented by the British Museum.*

BIRDS, Society for the Protection of. Educational Series. Nos. 1—24. *Presented by the Society.*

BOERHAAVE's Chemistry. London, 1735.
From Mr. J. H. Gurney, F.Z.S.

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ADDRESS.

Read by the President, SIDNEY F. HARMER, Sc.D., F.R.S., *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-second Annual Meeting, held at the Norwich Castle-Museum, March 26th, 1901.*

LADIES AND GENTLEMEN.—My first duty to-night is to return to you my most hearty thanks for the honour which you have done me by electing me as the President of this Society. I feel that I am under a special obligation to you because I am not a resident in Norwich. You have not only paid me a great compliment by not forgetting one who has had very few opportunities of being present at your meetings, but you were kind enough to ask me to fill the Presidential Chair even though you knew that my duties in Cambridge would prevent me from being present at several of the meetings held during my year of office. The interest which I take in my native city has led me to appreciate very highly the opportunity of taking office in this Society; and I have had an additional source of satisfaction in succeeding to the chair which was occupied by my father rather more than twenty years ago.

The event of most importance which has taken place during the past year is the death of Her Most Gracious Majesty Queen Victoria. The progress of science during her reign is a phenomenon which will perhaps never be repeated in the history of the world, and it will form one of the most important and interesting subjects to be dealt with by the historians of the Victorian Era. The adequate consideration of this topic would involve a complete survey of the state of the Natural Sciences before 1837, in order to be in a position to appreciate the advances which have been made since that date.

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The Biological Sciences, in which so many of us are interested, have shared to a striking extent in the general progress; and in particular the ideas suggested by Darwin and others in connexion with Evolution have not only revolutionised Biology, but they have permeated and influenced modes of thought in subjects most diverse from that to which they owe their conception.

The year has not passed without several losses by death of members of our Society.

Sir Francis Boileau, Bart., who died on December 2nd, 1900, was President of the Society for 1896—1897. He was well known throughout Norfolk as a public man and a philanthropist, and had filled many distinguished offices with success. He was President of the Norfolk and Norwich Archaeological Society at the time of his death; and his year of office in our own Society is so recent that his loss comes home to us with special force.

Mr. G. C. Eaton was a member of the Committee for many years. His kindly personality will be much missed at the Excursions of the Society.

Major G. N. Micklethwait, who was a Life Member of the Society, belonged to a family which has long been associated with Taverham, although he died at Bath but a few days ago.

The Right Hon. the Earl of Darnley, and Mr. P. Crowley, a well-known collector of objects of Natural History, were also Life Members who have died during the year.

The meetings of the Society have shown no falling off, either in the number of those attending or in the quality of the papers presented to the Society.

The April meeting in last year was not held, but the Society joined with the Norfolk and Norwich Archaeological Society in attending a Lecture delivered by Dr. C. B. Plowright, on "Woad: its Archaeology, Botany, and Chemistry, with special reference to the Art of Dyeing with it." The survival of the Woad Industry in East Anglia lends a special interest to the subject of Dr. Plowright's lecture.

On August 22nd I had the pleasure of receiving some of the members of the Society at Cambridge, when we inspected the

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Museum of Zoology and other Scientific Departments of the University, and spent the afternoon in visiting some of the Colleges.

On September 11th the Committee met to consider a letter from Lord Walsingham to your Hon. Secretary, asking for the co-operation of the Society in an attempt to re-introduce the Great Bustard into a district on the borders of the Norfolk Fens, formerly one of its favourite haunts in this country. I need hardly inform you that this attempt met with the cordial approval of the Committee, who thereupon issued a circular to the Norfolk County Council, the West Suffolk County Council, and the more important land-owners of the district in question, inviting them to take steps to avoid the destruction of the birds.

Mr. F. D. Longe has communicated to us papers on "A piece of Yew from the Forest-bed, apparently cut by Man," and "Flints." Our President-elect has read a paper on the use of the Teasel in Manufactures. From the Hon. Secretary we have had a paper on the Nitrification of Soil. Professor Newton has sent us his notes on the occurrence of bones of the Crane in the Fens; and Mr. T. Southwell has supplemented this by communications on the nesting of the Crane and the Curlew in East Anglia. Mr. J. H. Gurney has shown us a photograph of the nestlings of the Bearded Tit; while other communications relating to Vertebrates have been—Mr. A. Patterson's notes on Birds and Fishes at Yarmouth; Mr. E. J. H. Eldred's notes on Swifts; the Rev. M. C. H. Bird's papers on Vipers in Norfolk, and on Birds' Eggs and Nests; a note of my own on some markings on the skin of a Dolphin, as well as the usual reports on the Herring Fishery and on the recent additions to the Castle-Museum; Mr. W. H. Tuck's exhibition of a photograph of the nest of a Parakeet; and that by Mr. E. T. Roberts of a variety of the Great Tit. Invertebrates have been represented by the exhibition of Norfolk specimens of *Macrogaster arundinis* and *Nonagria brevilinea* by Dr. F. D. Wheeler, and of the Longicorn *Molorchus minor* by Mr. H. J. Thouless; by communications from Mr. W. H. Tuck on Aculeate Hymenoptera, and Mr. H. E. Hurrell on the Rotifera of Yarmouth;

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and last, but not least, by a most interesting summary by Dr. Sydney H. Long of the present state of our knowledge of the Mosquito-Malaria theory. Botany has been represented by fewer papers; but Mr. Geldart has communicated to us a paper by Mr. Dixon on Norfolk Mosses; and Mr. W. H. Burrell has given us an account of *Aecidium elatinum*, found parasitic on Silver Firs at Sheringham. In Meteorology we have had Mr. A. W. Preston's Notes for 1900, Mr. F. Dix's remarkable record of observations on rainfall, extending over sixty-three years, and a paper on Marsham's "Indications of Spring," by Mr. Southwell.

Several of these papers will appear in the forthcoming number of the 'Transactions.'

I am informed by the Hon. Secretary, to whom I have to express my best thanks for the help which he has given me during my year of office, that the number of members of the Society is 246. We have lost five members by death, and five by resignation; and we have elected eight new members during the year.

I trust that the finances of the Society are in a satisfactory condition. It was decided at the January meeting to contribute a sum of £2 2s. to the King's Lynn Museum now in process of re-organization; but the interest of our Society in that undertaking must not be measured by the smallness of the help we have been able to give.

It is my pleasing duty to acknowledge the receipt of presents of books from Professor Newton, Mr. J. H. Gurney, Mr. H. G. Barclay, and Mr. G. F. Buxton.

The special subject to which I wish to direct your attention for a short time this evening is *The study of the Natural History of Aquatic Invertebrates*. I propose to illustrate this subject by referring to the work of two of the zoologists of the first half of the Nineteenth Century, and to a few recent results selected to show that much yet remains to be done in the study of even our commonest animals.

The Invertebrate fauna of East Anglia has not received as much attention as it deserves to have bestowed on it. The coast of Norfolk does not indeed offer the same facilities for the study of

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the littoral fauna that are found in places where effective collecting can be done in the tide-pools of a rocky shore. Little has, however, been done in the way of dredging, although some information on this subject is contained in the scientific results of the German ship "Pommerania."* It appears from these results that the North Sea off the Norfolk coast is poor in species, many of the northern forms extending no further south than the latitude of Scarborough, while certain southern species which occur in the English Channel do not extend so far north as Norfolk. Although the number of species does not compare favourably with that found on other parts of the coasts of the British Isles, some of the species which occur in our own waters are represented by enormous numbers of individuals. This is not merely a fact which has come under my own observation, but it could be inferred from the importance of the East Coast fisheries, since the abundance of fishes is necessarily associated with an adequate food-supply. We are, however, far from knowing the facts with regard to the distribution of marine life in the North Sea.

Another direction in which observations are urgently required is the examination of the brackish and fresh waters of East Anglia. The salt marshes near Aldeburgh support a most interesting fauna, and I have little doubt that the same is true of other parts of the coast. The fauna of our rivers and broads has been but little explored, and it cannot be doubted that many discoveries remain to be made in these directions.

One of the most interesting fresh-water forms, which has been recorded from Norfolk at Lynn† and in the Bure District,‡ is *Cordylophora lacustris*. This species and several species of *Hydra* constitute almost the entire list of known fresh-water Hydroids; it is usually regarded as an introduced form, possibly imported on foreign timber.† It has been found in brackish water, as for

* 'II. & III. Jahresberichte d. Commission zur wiss. Unt. d. deutschen Meere in Kiel,' 1874.

† Allman, "Monograph of the Gymnoblastic or Tubularian Hydroids," Ray Society, 1871, p. 253.

‡ 'Nature,' vol. xliv., 1891, pp. 106, 445.

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instance in docks at London, but has succeeded in adapting itself completely to a fresh-water habitat.

Cordylophora has formed the subject of a recent note by Pauly,* who calls attention to the modifications in structure which have been connected with its migration from the brackish water at the mouth of the River Warnow, near Rostock, into the completely fresh water of the upper reaches of the river. The fresh-water specimens are much smaller† than those found a few miles off in brackish water; they branch much less freely; and gonophores are produced in smaller numbers. The change to fresh water has, however, its compensating advantages, since the number of polypes is much larger in specimens found there than in those which occur in the brackish water. This difference is not to be ascribed to the direct action of the environment, but it finds a much simpler explanation as the result of the observation that the brackish water forms are exposed in the summer to the attacks of a small Nudibranch Mollusc, *Aeolis exigua*, which systematically eats off all the parts of the colony which are not protected by perisarc. The Mollusc is unable to follow the Hydroid into fresh water. The facts connected with the distribution of *Cordylophora* in the Bure district are well worthy of further observation.

The need of work on fresh-water animals is well illustrated by a paper just published by Lauterborn,‡ with a view of calling attention to a special fauna and flora found in the Rhine district, in small ponds covered with Duckweed (*Lemna trisulca*). The bottom of a pond of this kind is covered by mud containing

* Zoolog. Anzeiger, vol. xxiii., 1900, p. 546.

† The measurements given are 0·8—1·5 cm. for specimens from fresh water, and 3—8 cm. for those from brackish water. There is a considerable discrepancy between these dimensions and the size of a large colony, 8 inches in length (=20 cm.), recorded by one of the members of this Society, Mr. Scherren, from the River Thurne, towards Hickling, attached to a *Potamogeton* ('Nature,' vol. xliv., 1891, p. 445). The measurements given by Pauly correspond more closely with those of a form from the River Elbe, described by Kirchenpauer as *C. albicola* (see Allman, *t. cit.* p. 254).

‡ Lauterborn, "Die 'sapropelische' Lebewelt," Zoolog. Anzeiger, vol. xxiv. 1901, p. 50.

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decaying remains of the Duckweed, the lower layers of which have a deep black colour and smell strongly of sulphuretted hydrogen. Mud of this character was found by Lauterborn to have a characteristic fauna, including the interesting Rhizopod *Pelomyxa* and numerous forms of Infusoria, and also a number of species of the little known group Gastrotricha, some of which were previously recorded from North America only.

But although much yet remains to be done in the mere recording of the species of aquatic animals found in Norfolk, my main object to-night is to call your attention to the importance of studying their Natural History. The determination of the species to which an Invertebrate belongs may be a matter which can only satisfactorily be dealt with by a specialist. The study of Invertebrates sometimes suffers from the want of easily accessible monographs. The literature of the subject is spread over an immense number of scientific memoirs, published in various languages, and often not to be found except in the largest libraries. It must therefore be admitted that a naturalist who takes up the study of a group of Invertebrates may less easily find guidance than one who devotes his attention to such groups as Birds and certain Orders of Insects But it is my object to show that the careful observation of some of the commonest and most readily determined Invertebrates not only has in the past resulted in important additions to our knowledge, but is still capable of leading to results of great interest.

As an illustration of the advances made in the past along these lines, I will direct your attention to two British Naturalists, John V. Thompson and Sir John Graham Dalyell, who will always take an honourable position in the history of the study of Marine Invertebrates. Most of Thompson's results appeared in the form of a few short memoirs entitled 'Zoological Researches,' published at Cork from 1828 to 1834. Short as these papers are, they contain a surprising amount of most important work. In the first memoir (1828) Thompson quotes the opinion of Dr. Leach that the higher Crustacea undergo no metamorphosis, and proceeds to show that this is so far from being the case that exactly the opposite statement should have been made. The organism known

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as a Zoaea, whose systematic position had been the subject of much dispute among Carcinologists, is shown to be the larval stage of an ordinary Crab. This is not merely advanced as an opinion, but its truth was demonstrated in the most satisfactory way by Thompson, who kept a Zoaea until it changed its skin, when it was found to have developed a set of appendages agreeing with the great chelae and the walking legs of a Crab, and further proved that the egg of the Edible Crab, *Cancer pagurus*, hatches out in the form of a Zoaea. In the same memoir he calls attention to the profusion of the minute floating animals of our own and other seas; and his statement that "the investigation of them holds out the promise of a rich harvest to the Naturalist, and a vast field of exploration replete with novelty and interest," is one which may well be commended to the attention of the members of this Society. After explaining the ease with which this fauna may be obtained by means of a "small towing net of gauze," he makes the suggestion, which I think has been somewhat forgotten, that pelagic organisms might be collected by applying a net of this kind to the spouts of the sea-water pumps of a ship under sail. This method has been quite recently employed with great success by Professor Herdman and Mr. Garstang.*

In the fourth memoir (1830) Thompson discusses the systematic position of the Cirripedes or Barnacles, which he shows from their development to be undoubted members of the Crustacea. He remarks that the metamorphosis which occurs in these animals is scarcely less wonderful than that implied in the belief formerly current that Barnacles were the young or embryo-state of certain species of Geese; a belief which, as he suggests, may have been connected with the instruction given in some Catholic countries to the "pious gourmet" that these Geese may be eaten during times of fasting and abstinence. This memoir contains an account of the Cypris-stage, or second larval form of Barnacles, and of its metamorphosis into a small edition of the adult form; and it finally disposes of the view that these animals are anomalous Molluscs.

* See 'Nature,' vol. lvi., 1897, p. 555.

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The fifth memoir (1830) is another classical work, which contained the first proof that certain Zoophytes which had till then been associated with the Hydroids have a structure which is essentially different from that of Coelenterates. Thompson here introduced for these Zoophytes the term Polyzoa, which is used, alternatively with Ehrenberg's name Bryozoa, as the class-name of this group of animals.

These results, which are by no means the only ones with which Thompson's name is connected, are a sufficient illustration of the advantage of a close observation of living animals.

Another writer, whose studies of the habits and life-histories of marine Invertebrate animals were attended with conspicuous success, was Sir John Graham Dalyell. An account of the life and work of this remarkable man, who died in 1851, is contained in the third volume of his work, 'The Powers of the Creator,' which appeared, after his death, in 1858. This work, and his earlier treatise, 'Rare and Remarkable Animals of Scotland' (1847, 1848), abound in accurate and well directed observations, accompanied by excellent figures, on the habits and structure of many marine Invertebrates. The discovery of the life-history of the common Jelly-fishes of our seas, described in the first volume of the 'Rare and Remarkable Animals of Scotland,' may well serve as a model of the way in which such investigations should be carried on.

It is true that the elder Sars had in 1835 given an admirable account* of the formation of Ephyrae by the transverse division of the so-called Strobila, and of the development of this stage from the Scyphistoma; although he had not ascertained that the Ephyra was a young form of the well known *Aurelia aurita*. But Dalyell's work was entirely independent of that of Sars, and his demonstration of the life-history was more complete. The *Hydra tuba*, or *Scyphistoma*, was found by Dalyell on the inner side of empty bivalve shells, its body measuring five lines in length. The specimens at first observed were kept for two years and a half,

* "Beskrivelser og Iagttagelser over nogle maerkelige eller nye i Havet ved den Bergenske Kyst levende Dyr," p. 16.

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during which time they fed voraciously on other animals, and gave rise to numerous broods of new Scyphistomas by budding, but underwent no other changes. The next step leading to the final discovery was the examination of a Jelly-fish (*Chrysaora isosceles*), which, after having been kept for a day in a glass vessel, was found to have laid a large number of eggs, which appeared as a fine dust at the bottom of the vessel. After thirteen days these eggs had developed into *Hydra tuba*. Before this time Dalyell had become familiar with the Ephyra, an organism one or two lines in diameter, found from February to March, and resembling "a flock of birds in distant flight, as represented by landscape painters." Although occasionally discovered in the open sea, they were chiefly observed in vessels containing the *Hydra tuba* or *Strobila;* and when removed from these vessels they were frequently replaced by others. Further observations showed in course of time that the fixed form was the origin of the Ephyra, the remarkable transverse division by which the *Hydra tuba* is converted into a *Strobila* taking place about March. Although Dalyell was not more successful than Sars in demonstrating the gradual growth of the Ephyra into the adult Medusa, the fact that the eggs of the Medusa had been shown to give rise to the *Scyphistoma* left no doubt that the life-history of the larger Jelly-fishes includes a fixed stage differing to an extraordinary extent from the adult form.

A more recent instance may next be taken, in further illustration of the results which may be derived from accurate observations on living animals. The observations of Mr. W. Garstang* on the respiratory phenomena of certain Crabs are of great interest, not only as throwing light on the mode of life of these animals, but also as showing that "small points of difference between species, which, as far as our ignorance permits us to judge, seem quite unimportant,"† may, with further knowledge, be ascertained to be of great importance in the life of the species.

* "Contributions to Marine Bionomics," Journ. Mar. Biol. Ass. vol. iv (N.S.), 1895—97, pp. 223, 396, 402; see also Quart. Journ. Micr. Sci. vol. xl. 1898, p. 211.

† Darwin, 'Origin of Species,' chap. iv.

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Corystes cassivelaunus is a Crab which is common in the deeper water all round the British Isles, and is characterised by the great length of its second antennae. These antennae can be apposed so as to form an elongated tube by the interlocking of two rows of hairs placed respectively on the dorsal and ventral borders of each antenna with the corresponding hairs of the opposite antenna. Mr. Garstang, while confirming the earlier observations of Robertson and Gosse that the tube formed by the antennae serves as a passage for the water used in respiration, adds important information with regard to the mode of action of this tube. *Corystes* has the habit of burrowing in sand, which it does by sitting upright on the surface and rapidly pulling itself backwards by means of its walking legs. It thus descends into a position where it is secure from the observation of predatory fishes, leaving only the tip of its antennal tube projecting beyond the surface of the sand. In this condition it remains during the day, but probably comes out at night to take food.

While in most of the Decapod Crustacea the water employed in respiration usually enters the gill-chamber beneath the branchiostegite and leaves it by an aperture placed at the side of the mouth, the current is constantly maintained in the opposite direction by a *Corystes* which is lying in the sand; the water thus entering the antennal tube, the hairs of which serve to prevent sand from coming in as well. The direction of the current is easily demonstrated by experiments with coloured water. Under certain circumstances, the current in *Corystes* has the same direction as in most other Decapods.*

This is, however, by no means the only case in which Mr. Garstang has been able to show that some of the most obvious external characters—for which no adequate explanation had previously been suggested—are similarly connected with the respiratory phenomena.†

* It has been shown by G. Bohn (Ann. Mag. Nat. Hist. (7) vol. i., 1898, pp. 17, 20) that the reversal of the direction of the respiratory current is a common phenomenon among Crabs.

† "The Function of Antero-lateral Denticulations of the Carapace in Sand-burrowing Crabs," Journ. Mar. Biol. Ass. vol. iv. (N.S.), 1895—97, p. 396.

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Most of the Cyclometopa, a group which includes the Edible Crab (*Cancer pagurus*), the Shore-Crab (*Carcinus maenas*), and many others, are well-known to have the front margin of the carapace conspicuously denticulated, although the purpose of this arrangement had not previously been ascertained. Many of these Crabs have burrowing habits; and actual observations on *Bathynectes longipes* at Plymouth showed that the animal comes to rest in such a position that the whole body is covered with sand, with the exception of the eyes and the anterior margin of the carapace. Against this are pressed the two great chelae, in such a way as to form two passages between themselves and the carapace. The entrance to these passages is guarded by the denticulations of the carapace, on which sand-grains were observed to rest. Coloured water was at once sucked down these passages to the gills. An important function of the denticulations of the carapace is thus shown to be the formation of a straining apparatus by which sand-particles are prevented from being introduced with the respiratory current. It is further shown that the various modifications of a certain carpal spine on the great chela, which has long engaged the attention of systematic Zoologists as an important specific character, are also correlated with the respiratory phenomena. The spine stops the flexion of the chela at the point which is most appropriate for enabling the appendage to take part in the formation of the respiratory passage; and "the variations in the form of the carpal spine in different species and genera are all functionally correlated with the different shapes and proportions of the carapace, and of the segments of the cheliped."

The results above indicated have been extended by Mr. Garstang by a study of preserved material of other species of Crabs;* and it can hardly be doubted that analogous phenomena are of common occurrence in this group. Thus in *Albunea*, which belongs to the Hippidea, a group widely distant from that to which *Corystes* belongs, a tube, presumably used in respiration, is formed by the

* "On some Modifications of Structure subservient to Respiration in Decapod Crustacea which burrow in Sand," Quart. Journ. Micr. Sci. vol. xl., 1898, p. 211.

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first pair of antennae, and is precisely similar in character to that which is formed by the next pair of appendages in *Corystes*. No better case could be given of the striking convergence in the evolution of a similar structure, in two animals which are not nearly related to one another, from two different parts of the body. In the Oxystomatous genus *Calappa*, an arrangement is present which resembles that of the common Cyclometopa of our own shores in the formation of a respiratory channel by the apposition of the great chelae to the anterior margin of the carapace; but in this case the denticulations which presumably serve to guard the entrance to the respiratory passage are formed by the upper margins of the "hands" of the chelae instead of by the edge of the carapace itself.

The question of the origin of species is one which has been in the forefront of Biological enquiries for the last forty years; but amongst the enormous mass of Zoological writings which have been devoted to the description of specific characters there are comparatively few papers in which an attempt is made to elucidate the utility of the characters by which species are discriminated. The solution of this question is, doubtless, at present beyond our powers in the vast majority of cases—and, indeed, it would be going too far to assert that specific characters, in general, have any distinct utility. But we may be the more grateful to enquirers like Mr. Garstang who succeed in finding a clue to some of the riddles of Nature, by observations which demonstrate some connexion between details which have usually been regarded as trifles useful merely in the discrimination of species, and some of the most important physiological phenomena in the life of animals.

The common Starfish (*Asterias rubens*) is well known to be one of the principal enemies of the Oyster; and it might have been supposed that the *modus operandi* of so common an animal in devouring its prey would have been accurately ascertained long ago. The manner in which Starfishes attack Molluscs has, however, formed the subject of a paper, by Dr. Schiemenz, published so recently as 1896,* in which the older opinions expressed on this subject are shown to have been erroneous. The following facts,

* Translated under the title "How do Starfishes open Oysters?" Journ. Mar. Biol. Ass. vol. iv. (N.S.), 1895—97, p. 266.

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taken from Dr. Schiemenz' paper, have considerable interest, not only from their practical importance, but as helping in the elucidation of the inter-relations between different organisms, and in giving some idea as to the functional importance of certain details in their structure. Schiemenz finds that Starfishes attack Molluscs in one of two ways. The first case is exemplified by *Astropecten aurantiacus*, which lives in sand, in which it pursues its prey. The Molluscs (Bivalves and Gasteropods) are pushed by its tube-feet into its mouth, which can be dilated to a surprising extent; and digestion takes place inside the stomach. One of the Gasteropods which lives in sand with *Astropecten* is *Natica* (*Neverita*) *josephinia*, a species which itself attacks bivalves, boring neat round holes in their shells by means of a gland which secretes an acid, probably sulphuric acid.* *N. josephinia* has a peculiarity, shared to a less extent by certain other species of the same genus, of being able to cover its shell with a lobe of its foot.

The fact that many Molluscs cover their shells, temporarily or permanently, with various parts of their soft bodies is one for which an explanation is needed, seeing that the shell of a Mollusc is presumably for the protection of the soft tissues. In this case it appears that the covering of the shell is a distinct protection against the attacks of Starfishes, as was shown by observing the way in which *Asterias glacialis* attacks the *Natica*. If the latter is crawling about, with its foot protruded, contact with a Starfish at once results in the shell-lobe being closed over the shell. If the *Natica* is retracted into its shell when it is attacked by the Starfish, a conflict ensues. The Starfish attempts to devour the Mollusc, which in its turn endeavours to protrude its foot from its shell. If the Starfish cannot prevent this, the foot swells up by taking in water, and it is then drawn tightly over the outer surface of the shell, thereby sweeping off all the suckers of the tube-feet of the Starfish, which are unable to attach themselves to the slippery soft tissues of the Mollusc, with which the victory remains.

A different result ensues in the event of the Starfish attacking

* Schiemenz, "Wie bohrt Natica die Muscheln an?" Mitth. Zool. Stat. Neapel, vol. x., 1891–93, p. 153.

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a Mollusc which cannot prevent the tube-feet of its enemy from maintaining a hold on its shell. Experiments were made with a species of *Venus* (*V. verrucosa*), which was always attacked in one particular way. The Starfish places its body over its victim, in such a way as to form a "mound," beneath which the *Venus* is concealed. The Mollusc lies with its hinge below and the junction of the two valves in a vertical plane. The peripheral tube-feet are attached to the ground, on which the distal halves of the arms rest in a horizontal position. The proximal tube-feet are fixed to the two valves of the *Venus*, and Schiemenz believes that the valves are finally opened as the result of a steady pull exerted by the tube-feet on the two valves. The process usually takes from fifteen to twenty minutes, at the end of which time the valves are separated widely enough to allow the Starfish to insert its stomach between the shells; digestion taking place in *Asterias* as the result of the eversion of the stomach.

The conclusion that bivalve Molluscs are opened by main force appears at first sight improbable, especially when account is taken of certain observations which show that a *Venus* can withstand a pulling force far greater than it would be fair to assume the *Asterias* to be capable of exerting. But Schiemenz meets this objection (1) by estimating by actual experiment the force which can be withstood by the joint action of the more centrally placed tube-feet of a Starfish; (2) by showing that the valves of a *Venus* can be pulled apart by a considerably less force than this, *acting for a prolonged period.*

The process of opening an Oyster was not actually observed, and it is obvious that the attitude assumed by a Starfish in relation to its victim cannot be precisely the same as in the case of the *Venus*, since the Oyster is attached to the ground. But reasons are adduced for believing that here, too, the Mollusc is opened by force. The shell of an Oyster has a laminated texture; and those which have been attacked by a Starfish are always found to have parts of the outer laminae torn off until a firmer part of the shell has been reached by the tube-feet. It is probable that a given Starfish cannot overpower an Oyster of more than a certain size.

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The practical importance of understanding the relation between Starfishes and Oysters may be realized by an estimate, quoted by Schiemenz, that the damage done by Starfishes to the Oyster-beds of Connecticut during the years 1887—1889 averaged half a million dollars annually, while that due to all other causes was less than a tenth of that amount. But my excuse for calling your attention to these facts is that we have here a forcible illustration of the utility of several structural features for which there is at first sight no obvious explanation. The temporarily internal condition of the shell of *Natica* is shown to help it to withstand the attacks of Starfishes; and the great development of the tube-feet in a Starfish is shown to have far more significance than would appear by assuming them to be merely organs of locomotion. It is hardly necessary to add that the theory of Natural Selection pre-supposes that the evolution of the organs of an animal has been directed by their utility to their possessor.

The coloration of aquatic animals is a subject which is still very insufficiently explored. Many species are known to be coloured in a distinctive fashion, and in some of these cases it is believed that the colours are of the nature of protective colours or warning colours;* or that the pigments may have a respiratory value. The need of further observations on this subject is well shown by a consideration of the results arrived at by Messrs. F. W. Gamble and F. W. Keeble.† It is well known that certain Crustacea are variable in colour; or that they can change their colour, an individual of certain species being under some conditions coloured in one way and under other conditions in another way. As examples of species which are known to change colour individually, may be mentioned the common prawns *Palaemon serratus* and *Pandalus annulicornis*. One of the most variable species is *Hippolyte varians*, the subject of the memoir by Dr. Gamble and Mr. Keeble, a species commonly found in tide-pools

* For a consideration of this subject in Nudibranchiate Molluscs see W. A. Herdman, Quart. Journ. Micr. Sci. vol. xxxi., 1890, p. 55.

† "*Hippolyte varians*: a Study in Colour-change," Quart. Journ. Micr. Sci. vol. xliii., 1900, p. 589. A preliminary notice was published in Proc. Roy. Soc. vol. lxv., 1900, p. 461.

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or in the Laminarian zone in many parts of our coast. The range of colour is very striking; brown, red, blue, and green shades occurring in endless variety, some specimens being coloured in a uniform manner, whilst others are semi-transparent, with pigmented lines and other markings in different parts of their bodies. The phenomenon of protective coloration is very conspicuously seen, the individuals commonly harmonising to a remarkable extent with their surroundings. The species is of very sedentary habits, and "its prime object in life is to anchor itself" to some seaweed or other object which it commonly matches in colour.

Messrs. Gamble and Keeble have carried on a careful and elaborate series of observations with the object of ascertaining the real facts with regard to the colour-changes. They find that immature specimens show the most remarkable colours and resemblance to their surroundings; and that the females not only have more elaborate patterns than the males, but are "more resourceful" in adapting themselves to their surroundings than are the members of the other sex. It is suggested that this difference is perhaps correlated with the more sluggish habits of the female, which is usually burdened with a load of eggs or developing larvae, and has therefore more need of protective coloration than the male. A number of *Hippolyte* of different colours were placed in a dish, to which a selection of sea-weeds was then added. After a time they were found to have matched themselves with remarkable accuracy to the sea-weeds, each colour-variety deliberately selecting a sea-weed which it resembled in tint. When an individual is placed with a weed of a new colour, it is slow to respond to its altered environment. Green specimens placed with brown weed were found to retain their green colour, even for a week or more, although in the end they adopted a brown tint. The recovery to green was more rapid when they were again placed with green weed. It thus appears that the resemblance between the prawn and its environment is not due to any power possessed by the *Hippolyte* of adapting itself rapidly to its surroundings. Each individual seems to remain in the environment which

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suits it best, without adapting itself in succession to a series of differently coloured weeds.

A very different result was obtained by altering the intensity in the illumination of the specimens; and definite colour-changes were rapidly induced by changes in the intensity of the light. Some evidence was obtained that the periodic rise and fall of the tides thus affects the colour. Specimens taken at low spring-tides were of a lighter colour than those which were trawled in the same places in higher states of the tide, when the prawns were covered with several feet of muddy water.

The most striking individual change is, however, that which is associated with nightfall. Every evening, at a time which alters with the seasons, a reddish tint makes its appearance in each *Hippolyte*. This is followed by a change to green, which "gradually melts into blue," the body becoming at the same time more transparent. "Thus, as darkness falls, *Hippolyte* is seen to become of a wonderful azure blue colour and absolutely transparent, except in the region of the liver and stomach, which are now very clearly visible." The depth of the blue colour varies, the more deeply pigmented specimens becoming more blue than those which have less pigment. This nocturnal blue colour may be replaced by the diurnal colour in less than a minute when the prawn is exposed to incandescent gas-light.

The colour-changes are due to the existence of "chromatophores," which occur in the connective tissue, in definite relation with the skin, the digestive organs, or the vascular and muscular systems. Each chromatophore is a body which passes into excessively fine, branched, tubular processes; and it contains red, yellow, and blue pigments. In nocturnal specimens the red and yellow pigments are for the most part retracted into dense masses whose superficial area is so small as to produce no great effect on the general coloration; the blue pigment, on the contrary, being spread out through the whole of the chromatophore and the fine reticulum of tubules which surrounds it. During the day, the chromatophore usually consists of red and yellow pigments; and it may hardly be possible to distinguish any trace of the blue colour.

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I have indicated above a few only of the observations made by Messrs. Gamble and Keeble. The subject is one of considerable complexity, and there are many points involved which have not yet received any satisfactory explanation. The object of the nocturnal blue colour, for instance, is at present obscure, although the authors of the memoir suggest as a possibility that it may be "a nightly reversion to the blue-green colour so characteristic of pelagic animals," or possibly a means of adaptation to the surroundings at night. It is suggested that the brilliant red colours recorded in deep-sea Crustacea may be quite different from the natural colours. Abyssal life is associated with conditions of darkness, and it is possible that the red colour is, in some cases at least, merely one which is assumed during the passage to daylight of an animal which normally resembles the nocturnal *Hippolyte* in its coloration. The account of this species is of interest not merely on account of the facts recorded with regard to a very complex subject, but as directing attention to the need for further investigations on the coloration of marine animals.

I may perhaps be excused for making a few references to the Polyzoa, the group of animals in which I have taken an especial interest. Although but little attention has been given to these animals in Norfolk, I have no doubt that a proper search would result in the discovery of a considerable proportion of the British fresh-water forms within the limits of our own county. Magnificent colonies of *Cristatella* and *Plumatella* are common on the leaves and leaf-stems of Water-lilies at Cringleford. The former animal is almost unique in being a colonial animal which is endowed with the power of moving from one place to another in a Slug-like manner. The Phylactolaemata, to which most of the fresh-water genera belong, are peculiar in developing a remarkable form of reproductive body known as a "statoblast," and usually regarded as a special form of internal bud. These structures possess a chitinous biconvex shell, surrounded by an "annulus" of air-cells. After the conclusion of the summer, at which period the colonies die down, the statoblasts are set free, and float to the surface of the water. One object which is thereby attained is no doubt the

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distribution of the species; but it has been shown experimentally by Braem* that the germinating power of the statoblast may be improved by exposure to the action of frost.† There can be no doubt that the statoblasts are a special adaptation to the conditions of fresh-water life:—in the first place, because they are only found in the forms which inhabit fresh water; and in the second place because very similar structures are found in totally different groups of fresh-water animals. The so-called winter-eggs of the Crustacean *Daphnia* and its allies are enclosed in a bivalve shell, the so-called "ephippium," which has a striking similarity to a statoblast; and an arrangement not unlike the annulus of a statoblast is even present in the egg of *Anopheles*,‡ the Gnat which has obtained so wide a reputation as the means by which the Malaria-parasite is carried from one human "host" to another.

The genus *Plumatella* includes several forms of very distinct habit. Those which are characterised by having their tubes parallel with one another and at right angles to the substratum on which they are growing were formerly placed in a distinct genus, *Alcyonella*. There is, however, no reasonable doubt that *Alcyonella* is merely a form of *Plumatella*; and Kraepelin§ goes so far as to regard *Alcyonella fungosa* as a particular state of growth of *Plumatella repens*. Wesenberg-Lund|| regards them as belonging to two distinct species, but he shows that the form of the colony is greatly influenced by the amount of room which it has at its disposal. If a number of statoblasts germinate close together on

* "Unt. üb. d. Bryozoen d. süssen Wassers," Leuckart & Chun's 'Bibliotheca Zoologica,' Heft 6, 1890, p. 82.

† See, however, Wesenberg-Lund (C.), "Biologiske Studier over Ferskvandsbryozoer," 'Vid. Medd. naturh. Forening' (Copenhagen), 1896, p. xxix.

‡ Nuttall (G. H. F.) & Shipley (A. E.), "Stud. in relation to Malaria." II. 'The Structure and Biology of *Anopheles*,' Journ. Hygiene, vol. i, No. 1, 1901, p. 49.

§ "Die Deutschen Süsswasser-Bryozoen," Abhandl. Ver. Hamburg, vol. x., 1887, p. 122, etc.

|| *T. cit.* p. vii.

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a single water-lily leaf, the originally distinct colonies of *Pl. repens* become so crowded together as to assume a somewhat Alcyonelloid appearance. Colonies of this type occur, with the typical *Pl. repens*, at Cringleford. *Pl. fungosa* owes its origin, according to the same author, to the germination of *a number* of the so-called "sessile" statoblasts on some cylindrical object. The juxtaposition of these statoblasts results in the crowded growth which is so characteristic of *Pl. fungosa*. Wesenberg-Lund has made the further observation that the old colonies, which may be as large as a child's head, are the result of several years' growth; and that when cut vertically they show one or two dark annual rings, indicating that the colony is two or three years old, as the case may be. It is not certain whether the new growth which takes place in the spring is the result of the germination of statoblasts in the old tubes, or whether the old individuals remain alive through the winter and start a fresh growth in the spring. Further observations on this subject would be of interest.

Turning to marine Polyzoa, I would direct your attention to the remarkable structures known as "avicularia," which are found in a large proportion of the Order Cheilostomata. These curious structures are regarded as modified individuals of the colony, in which the "operculum" which closes the orifice of the ordinary individuals has been modified into the "mandible" of the avicularium. They owe their name to the extraordinary resemblance possessed by the most specialised type of avicularium to a bird's head. In the common genus *Bugula*, each is mounted on a short stalk, on which it executes various movements; the jaws being used for the capture of organisms which stray over the surface of the colony. So much is well ascertained, but it is by no means easy to know whether the avicularia perform any function other than that of defence; since they are totally devoid of digestive organs and, moreover, have no power of passing the substances they have caught to the mouths of the ordinary individuals.

The subject is well worthy of further observation made on the living colony; but I have ventured to suggest* that one of their

* Quart. Journ. Micr. Sci. vol. xliii., 1900, p. 236.

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most important functions is probably to prevent the larvae of other animals from fixing on the surface of the colony. The life of the Polyzoa is absolutely dependent on a free access of water containing the minute organisms on which they feed to the mouths of the active individuals of the colony. Encrusting species belonging to their own class, or to Sponges, Tunicates, and other animals, are thus dangerous foes, and they are ready enough to take advantage of any opportunity of growing over a Polyzoon of suitable form. This overgrowth is, however, certainly not marked in the living parts of the colony; and it appears to me highly probable that the avicularia help to prevent it by destroying or disturbing those larvae of encrusting animals which attempt to fix in their neighbourhood.

The necessity for maintaining an unobstructed flow of water makes most Polyzoa intolerant of mud, but it is worth noticing that there are a few species which have succeeded in adapting themselves to the muddy conditions found in many parts of our East Coast and elsewhere. Of these I may specially mention *Anguinella palmata*, which, although accounted a rarity, occurs in great profusion between tide-marks at Dovercourt. A few other species such as *Vesicularia spinosa*, *Alcyonidium gelatinosum*, and others, are common in the muddy estuaries of the Suffolk coast.

I have attempted this evening to give a few instances to show that the study of our Invertebrate fauna is one which is full of interest; not merely from the point of view of recording species, but also in ascertaining the details of their life-history, the foes they have to contend with, and the utility of their several parts. Many of the most important advances in our knowledge of Invertebrates have been made by the careful observation of the living animals; and as instances of this I have cited some of the observations of J. V. Thompson, Sir J. G. Dalyell, and others. But much remains to be done in this field. The study of the life-histories of Insects is a pursuit in which great advances have yet to be made. The works of Professor Miall,* on Aquatic Insects

* 'The Natural History of Aquatic Insects,' 1895; and 'The Structure and Life-History of the Harlequin Fly (*Chironomus*)' (Miall & Hammond), 1900.

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and their transformations, will serve as an admirable introduction to this fascinating study; while many of the phenomena of the life-histories of other Insects, and particularly of the Hymenoptera, have recently been sketched in a most attractive form by Dr. Sharp.* This, however, by no means exhausts the list of animals in which there is a promising field for research; and it appears to me that some of the members of our own Society would do well to turn their attention to certain Invertebrate groups whose study is usually restricted to specialists. The life-histories of parasitic animals are of absorbing interest, besides being of great practical importance.

If I have ventured to put forward a plea for the study of the lower animals, it is with no wish to underrate the importance of devoting attention to those which share with ourselves the dignity of belonging to the Vertebrata. But the Vertebrates constitute, after all, no more than a single type of animal structure; and there are many others which equally merit attentive study. I have endeavoured this evening to bring a few cases to your notice with the object of showing that the observation of the conditions under which Invertebrate animals live, and of the details of their life-histories, is a study which will yield to no other in interest.

"The minutest Works of Creation are not always the least wonderful." †

I have trespassed too long on your time, and I will conclude with some words of a writer of the end of the Eighteenth Century:—"He that is delighted with the Works of Nature, and makes them his Study, must undoubtedly be happy; .....each Garden or Field is to him a Cabinet of Curiosities, every one of which he longs to examine fully; and he considers the whole Universe as a Magazine of Wonders, which infinite Ages are scarce sufficient to contemplate and admire enough." ‡

* "Insects," Cambridge Nat. Hist., vols. v., vi., 1895, 1899.

† J. Ellis, "Essay Nat. Hist. Corallines," 1755.

‡ Baker, "Of Microscopes," Introduction to Vol. I., New Ed., 1785.

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I.

WOAD AS A BLUE DYE, WITH AN ACCOUNT OF ITS BIBLIOGRAPHY.

By C. B. Plowright, M.D.

Read 25th April, 1900.

"As blue as Wad" is an old Norfolk saying applied by our grandparents as occasion arose, but notably to badly washed linen, when the laundress sought to hide her inefficiency by an extra dose of the blue bag, or to an unfortunate ague-stricken patient in the cold stage. The excellent paper by Mr. E. Corder,* which appeared in our 'Transactions' for 28th October, 1890, has so thoroughly gone into the whole matter of East Anglian Woad culture and preparation that the present remarks must be regarded as quite supplemental to it, having been, in fact, inspired by it. Frequent visits have been made to the Parson Drove Woad Mill, and a long series of experiments conducted before the blue colour, the indigo in fact, in this Woad could be demonstrated. Curiously enough the subject has engaged the attention of Professor Beijerinck† of Delpht, and by his help the presence of indigo was easily shown in the fresh plant from Parson Drove. The blue colour of Woad is indigo, $C_{16}H_{14}N_2O_2$. The same substance chemically as that obtained from *Indigofera tinctoria* and *Polygonum tinctoria*. There is this great difference however: in the last named plants it exists in a form which is easily extractable, whereas in Woad it exists in a condition which is the very reverse.

In 1855, Dr. E. Schunck,‡ in an exhaustive paper on the

* Corder E. Trans. Norfolk and Norwich Nat. Soc., 1890, vol. v. p. 144.

† Beijerinck Prof. M. W. "On the formation of Indigo from Woad." 'Koninkijke Akademie van Wetenschappen te Amsterdam,' 1899, p. 120. 30th Sept.

‡ Schunck Dr. E. "On the formation of Indigo from Woad." 'Philosophical Magazine,' vol. x. p. 74, 1855.

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Chemistry of Woad, drew attention to the fact that indigo did not exist as ready formed indigo-white in this plant. He showed that a substance, indican, $C_{26}H_{31}NO_{17}$, one of sugar series, was the form from which indigo-white was produced by oxidization.

In 1877, M. Alvarez* attributed the formation of indigo to the action of bacteria, but in 1898 Bréaudat† demonstrated that microbic life was not necessary.

Marchlewski and Radcliffe‡ consider indican consists of sugar and a very unstable substance called indoxyl ($C_8H_7N.O.$). Prof. M. W. Beijerinck holds the view that the indigo producing plants may be divided into two groups, in one of which this substance exists as indican (*Indigofera tinctoria* and *Polygonum tinctoria*), while in the other (of which Woad, *Isatis tinctoria*, is the type) it exists as indoxyl. More recently, however, Beijerinck§ ‖ has come to the conclusion that even indoxyl does not exist ready formed in Woad, but that it exists as a "loose compound" isatan, which by an enzyme isatase also present in Woad is easily decomposed into indoxyl.

Be this as it may, it is not difficult to extract indigo blue from fresh Woad leaves by the process given by Beijerinck. This consists in packing fresh Woad leaves into a stoppered bottle and filling the bottle entirely with boiling water: inserting the stopper so that no air-bubble is left between it and the top of the water: after a few hours the infusion will be found of a pale yellow colour, having, when cold, a green fluorescence. If an alkali be added to this infusion and air blown through it, indigo blue is precipitated on the further addition of an acid. Woollen articles dipped into this alkalised infusion, become on exposure to the atmosphere a pale azure blue. This change, however, takes place far more rapidly if they be dipped into acidulated water. The indigo thus obtained is, however, very apt to contain impurities; notably, to pass into

* Mons. Alvarez. 'Comptes rendus,' vol. 105, p. 287, 1887.

† Bréaudat L. "Sur le mode de formation de l'indigo," 'Annales d'Hygiène et de Medicine Coloniales,' vol. i, 1898, No. 4, Oct.-Nov., p. 535.

‡ Marchlewski and Radcliffe. 'Journal of the Society of Chemical Industry,' 1898, p. 443.

§ Beijerinck M. W., *loc. cit.* "Further researches on the formation of Indigo from Woad." June 30th, 1900.

‖ Beijerinck M. W., *loc. cit.* "On Indigo formation." Mar. 31st, 1900.

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a condition known as indigo-brown, in which an insoluble black-brown substance is formed which is useless to the dyer, and cannot be re-converted into indigo blue. During the unsettled state of Europe towards the end of the eighteenth and beginning of the nineteenth century, numerous attempts were made to manufacture indigo directly from Woad; prizes were offered by various governments for the attainment of this object in order that the use of foreign indigo might be obviated, as it could only be obtained with difficulty. None of these processes were ever practically successful.* Many of them were entirely theoretical. Some sought to obtain indigo by macerating fresh Woad leaves in cold water, others in warm water, others infusing them in boiling water, and subsequently washing with cold.

The full details of these essays are given by Giobert,† who with Du Puymaurin,‡ came nearest success.

To demonstrate the presence of indigo in the Woad leaf, the process of Dr. Hans Molisch§ is the best. This consists in keeping the fresh leaves in a wide-mouth stoppered bottle, filled with gaseous ammonia for twenty-four hours, and then dissolving out the chlorophyl by immersing the leaves for a like period in absolute alcohol. Sections show that the indigo is confined to those tissues which contain chlorophyl, and that the hairs, cuticular cells (excepting the guard cells of the stomata), and fibro-vascular bundles are free from it. When the chlorophyl has been thus extracted, the leaves have a blue colour of greater or less depth according to the amount of indigo they contain.

Although the extraction of indigo is so difficult and unsatisfactory a process, yet Woad has been used as a blue dye from remote antiquity.

* Amongst these suggested processes were those of the German chemist Justi; Astruc, 1737; Hellot, 1750; Borth, 1764; Kulenkamp, 1755; Eddel, 1756; Morrina, 1791; Nazarow, 1810; Dambournay, Pavie, 1811; Cioni, 1812; Michelotti, 1811; Bonfico, Heinrich, 1812; Du Puymaurin, 1810—1812; Giobert, 1813; Reinwardt, 1812.

† Giobert. 'Traitè sur le pastel,' Paris, 1813, 8vo.

‡ De Puymaurin. 'Sur le Pastel: sa culture et les Moyens d'en retirer l'indigo,' 1810, 8vo.

§ Molisch Hans. "Ueber das Vorkommen von Indican in Chlorophyllkorn der Indicanpflantzen." Bericht der Deutsch. Bot. Gesell. 1899. Bd. xvii. Hf. 6, p. 228, t. xviii.

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Pliny* refers to it as having been used to stain chalk blue for the adulteration of indigo, which was then a pigment of great rarity, as it had to be imported by the "overland route" from India.

Besides the Norwich Indenture given in Mr. Corder's paper there exists a still earlier Norfolk record of Woad in the "Composicio Lennæ,"† which was an agreement between William de Raleigh, Bishop of Norwich, and the Earl of Arundel, made in the year 1243. The original of this document is not in existence, but there is a copy of it in the archives of King's Lynn. This roll was made probably in the reign of Edward III., and shows the "custumies de la Tolboth de Lenn."

A list of the tolls payable includes Woad under the name Wad, viz.—

WAD.

Of ev'y tonne wt. Wad	...	...	iiijd
Of ev'y frayel Wad	...	...	iiijd
Of di: frayel ...	...	...	ijd
Of j quart' ...	...	...	id
Of di quart' ...	...	...	ob
Benethe rist not	...	...	nl

These are practically the same dues, fourpence per cask (doleo), and the like sum per basket (fraillo) as were payable in Norwich. The survival of the word frail in East Anglia is also interesting, it being still applied to a basket made of bulrushes (*Scirpus lacustris*).

In Customs Roll of Lynn, 1302—3, reference is made to the import of eleven casks of "Wayd" from Amiens‡

Mr. Walter Rye draws my attention to the fact that in John the Libester's rebellion in 1381 the rebels stole from the house of Henry Lomyner a "pokett of wad" valued at 100s. (Powell's 'Rising in East Anglia,' p. 30). He also points out that no less than *five* people of the name of Lister were implicated in the rebellion, that Lister means cloth dyer ('Prompt. Parvul.' p. 307), and suggests that one of the predisposing causes of the riot may have been the introduction of a new dyeing process by the Flemish, who seem to have been the special object of the fury of the mob.

The first printed reference to Woad as a blue dye occurs in Ruellius,§

* Pliny. Nat. Hist. vol. xxxv. 6.

† Howlett R. 'Norfolk Antiquarian Miscellany,' vol. iii., 1887, p. 603.

‡ Howlett R. 'Norfolk Antiquarian Miscellany," vol. ii. p. 527.

§ Ruellius J. 'De Natura Stirpium,' lib. ii., folio, Paris, 1536, p. 574.
" " " " Basle, 1537, p. 434.

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'De Natura Stirpium,' 1536, where the following passage occurs:—

"Viridem herbam trusatilibus molis premunt, ut herbaceam saniem excludant: dein abacto liquore digerût in magnos globos, quos tabulatis in cinerem computrescere sinunt, pastellum plerisque locis ab effigie pastellorum in quam glomerantur, nominantes. Hos continis infectoriæ coquunt officinæ, et laneos pannos ac vellera demergunt ut cœruleum ebibant colorem. Cœruleum illam spumam innatantem quam igni conferuescentes eructant cortine, indum nostri vocant infectores hanc ad pictorum usus siccant."

That is to say, "They crush the green plant in mills, so as to expel the vegetable juices, then when the moisture has been removed they make the Woad up into large balls, and these they allow to lie on the floor and decay till they fall into ashes (dust). In many places they call Woad, 'pastel,' from the loaf-like shape into which the Woad balls are made up. They heat (the dust of) these balls in vats, in dyers' shops, and dip woollen cloths and skins therein, that they may absorb the blue colour. The blue scum floating on the surface, which the vats throw up when warming on the fire, our dyers call indigo: this they dry for the use of painters."

In 1555 Crolach* published his small book on Woad and its culture and preparation, from which it appears that Thuringia, one of the great Woad producing districts of Europe, was already beginning to feel the effect of the introduction of indigo into Western Europe by the Cape route. A century later this was more pronounced, judging from what Wedelius† says. His account of the Woad industry is very good; so much so that Ray,‡ the first professor of botany at Cambridge, copies it almost verbatim with due acknowledgment, which in its turn was copied and translated by the author of the English Edition of Tournefort's Herbal.§ The latter tells us, "the ground, which is plow'd in *Autumn*, must be left all *Winter* to be soak'd by the rain, till

* Crolachius H. 'Isatis herba de cultura Herbæ Isatidis quam guadum vulgo vocant.' 12mo. Tiguri, 1555.

† Wedelius Geo. W. 'De sale volatile plantarum.' 12mo. Jena, 1675, captin VII. and VIII.

‡ Ray John. 'Historia Plantarum,' fo. 1686, vol. i. p. 843.

§ Tournefort. 'The Complete Herbal or Botanical Institutions of Mr. Tournefort.' 4to. London, 1719, vol. i. p. 392—395.

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the Purification of Our Lady. After *Lady Day*, when the air is somewhat softer and milder, it is proper to sow it, and your end will be better answer'd if you sprinkle a little snow over it, and take care that you do not sow it too thick . . . . . and after *Whitsuntide* you must weed all other herbs from it. After *St. John's* Day in the Beginning of Harvest it is ripe." It is interesting to add that the wadmen of the present day say that, "no Wad should be gathered after Martimas Day" (15th November.) Wedelius was essentially a chemist, and the main object of his book was to show that ammonia was produced from plants. He showed that ammonia was given off in large quantities during the couching of Woad, and he also argued on theoretical grounds that Woad contained sulphur, in both of which assertions he was correct. He tells us, as early as 1577 a decree was made at Frankfort to prevent the fraudulent and injurious substitution of indigo for Woad, and on 21st April, 1654, at Ratisbon, an edict was promulgated inflicting the penalty of confiscation against the further importation of indigo. The days of Woad as a dye were however rapidly drawing to an end, and yet, paradoxical as it may seem, the dyers of the "greater dye" could not do without it. At this time no other equally good method was known by which indigo could be dissolved and used for dyeing. We find Woad culture an important industry during the seventeenth and eighteenth centuries; accounts are to be found in the contemporary agricultural writers—Ellis,* Trowell,† Miller,‡ and Young.§ It was mostly carried on by itinerant "wadmen," who, with their families travelled from place to place, growing the Woad on newly broken up pasture land for which very high rents were paid. These gangs built their huts and wad mills with the sods from off the land, and were brought up to the industry from their childhood. They seldom stayed more than two or three seasons in the same spot, moving to a fresh location as soon as the soil became exhausted. Abroad the

* Ellis Wm. 'The Modern Husbandman,' vol. iii. 1744, p. 117—118.

† Trowell Samuel. 'Treatise on Husbandry and Gardening.' London, 8vo. 1739.

‡ Miller P. 'The Gardener's Dictionary,' 7th Edition, folio, 1759, article "Woad."

§ Young Arthur. 'General View of the Agriculture of Lincolnshire,' 8vo. 1799.

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Schreber's* monograph, published in 1752, gives a very complete account, not only of the culture, but of the history of the subject, as well as copious extracts from the more important writers on the subject, with copies of the various proclamations, edicts, etc. In the appendix to this volume a German translation is given from Hellot's† chapter on dyeing wool with indigo and Woad. This book (Hellot's) was subsequently translated into English, anonymously.‡ Under the "greater dye" or dyeing "colours in grain," it gives the modus operandi of working a Woad or pastel vat, which was the best then known way of dyeing with indigo. The directions are sufficiently quaint; for instance, the writer begins by saying, "Your copper cauldron should be placed as near as possible to the vat, and then filled with pond water: if the water be not sufficiently putrid you put in a handful of hay. When the copper is full the fire should be lighted under it at three o'clock in the morning." Then again, for every ball of pastel you throw in a full measure of "*ware*" (slaked lime), and sundry mysterious stirrings and coverings are enjoined, until the vat has "come to." When the indigo is put into it, there follow more stirrings and additions of Ware, until the vat is ready for the "overture," or first piece of stuff to be dyed. "Towards the latter end of the week you dye the light blues, and on Saturday night, in order to preserve it 'till Monday, you *garnish* with a little more ware than on the day preceding." On Monday morning the vat was reheated, fresh indigo added to replace that which had been taken out by articles dyed during the preceding week, while bran and lime were added in the proper proportions. In point of fact a Woad vat, once started, was kept going for many weeks or months, adding the indigo from time to time as required, as well as the requisite proportion of bran (sharps) and slaked lime (ware). The whole process was an exceedingly delicate one; if the lime was deficient the vat became putrid, if used too freely the vat "got the kick," and did not work at all: this was also the case if the proper temperature was not maintained.

* Schreber D. G. 'Historische physische und œcomonische Beschreibung des Waidtes.' Halle, 1752, 4to. with plates.

† Hellot. 'L'art de la teinture,' 1750.

‡ 'The Art of Dying Wool, Silk, and Cotton,' 8vo. London, 1789.

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What really takes place in a Woad vat is concisely this:—Indigo blue is a very insoluble substance; it will not dissolve in any of the ordinary solvents such as hot or cold water, dilute acids, alkalies, alcohol, ether, chloroform, etc. Hence it is a very fast dye if it can only be made attach itself to a fabric. In order that this may be done it is necessary to dissolve it; but as we have seen, none of the ordinary solvents will do this. What happens in the Woad vat is this: the chemical composition of the insoluble indigo-blue is altered, it is, as chemists say, reduced to indigo-white; now indigo-white is soluble in weak alkaline solution, hence the use of the slaked lime. If a skein of wool be dipped into a vat containing indigo-white in this state, the solution soaks into the tissues of the wool fibres; when the wool is taken out and exposed to the air the oxygen unites with the reduced indigo, and the skein passes from a greenish yellow to a deep blue, the insoluble indigo-blue being thus formed and the fabric dyed in such a way that no mordant is required. The chemical changes which take place in the Woad vat when once started are, that the starch of the bran is converted into grape sugar, which becomes lactic acid. The lactic acid becomes butyric acid, and in so doing nascent hydrogen is liberated, which reduces the indigo to indigo-white.* Indigo is soluble in strong sulphuric acid, and there are other processes by which it can be reduced, but the above is the rationale of the Woad vat, which has held its own from the time when the mediæval dyers added a little indigo to the vat to improve the colour of the blue down to this present time. It is an expensive, awkward, and difficult process, but it has this one advantage: the colour produced is extremely durable. In actual practice a little madder is added: this is done, the dyers say, "to kill the green" in the indigo.

Woad was used long before indigo came into Europe, not as a solvent, but as a dye *per se*. Woad contains no indigo ready formed; not the slightest trace of any blue colour can be detected in it. With water it forms a dark-brown mixture which colours woollen fabrics olive-green. In order to dye with Woad all that is necessary is to pour boiling water on the Woad, and keep it in a well-covered vessel for 15 or 20 hours at a temperature of about

* Rawson Christopher. Cantor Lecture. 'Journal of the Society of Arts,' vol. xlviii. Ap. 6, 1900, p. 424.

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110° to 140° F., not going above 150° or letting it fall below 100°. In about 13—14 hours bubbles of gas begin to rise; a very small quantity of slaked lime should now be added; and in a few hours woollen articles allowed to remain in it for an hour or two change from yellow to blue as they are taken out and exposed to the air. When the vat is in full working order the liquid is of an olive-brown colour, on the surface of which darker veins appear which change their position, slowly moving, appearing and disappearing spontaneously. The froth which at this time gathers on the surface of the vat is blue from the indigo precipitated by contact with the atmosphere. This constitutes the *cæruleum spumam* Ruellius* speaks of as being dried and sold to the painters. It was also the "flowers of the Woad" which the dyers of Coventry† were accused of skimming off the Woad vats in which they dyed their customers' goods and added to those vats in which they dyed their own. It is interesting to notice that if a skein of wool be suspended in a small experimental vat in good working order, that it is the upper part of the skein nearest the surface which takes the deepest colour, and next to it, as one would have imagined, the lower part nearest the sediment at the bottom. This blue scum was the probable source, not only of the Woad blue which Pliny‡ speaks of as being used in his time to stain chalk with for the adulteration of indigo, but also of the "ancient Briton" pigment of which we hear so much and know so little. Cæsar§ and Pomponius Mela‖ speak of our ancestors staining their bodies blue; it is difficult to understand how they could dye their skin blue, but is easy to see how they could have smeared themselves with Woad blue mixed with oil or grease. Herodian,¶ however, throws a little more light on the subject when he tells us that "they mark their bodies with various figures of all kinds of animals, which is the reason they wear no clothes, for fear of hiding these figures." The use of indigo for tatooing is still common among our soldiers and sailors. In conclusion I must express my thanks to Mr. C. G. Barrett, of Gaywood, for his valuable assistance and advice in conducting the numerous experiments with Woad vats which have been made.

* Ruellius, *loc. cit. ante.*

† Petitions to Parliament, III. Henry V. (1415), for which reference I am indebted to Mr. Walter Rye.

‡ Pliny, Nat. Hist. xxxv. 6. § Cæsar, 'De Bello Gallico,' v. 14.

‖ Pomponius Mela, ii. 1. ¶ Herodian, iii. 47.

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II.

ON THE USE OF THE TEASEL IN NORWICH.

By W. H. Bidwell.

Read 6th November, 1900.

A Norwich factory has lately been dismantled, and the workmen engaged found the remains of an old gig mill, the iron frames of which were still fitted with the burs of the Fuller's Teasel (*Dipsacus fullonum*). The gig mill is still used in the West of England for dressing the best cloths; but it is so long since any teaseling was done in Norwich, that it seemed that one of these frames, which is exhibited this evening, would prove of sufficient interest to be placed in the Museum.

These frames were fixed on a large wheel, which revolved, and the cloth was drawn under it, moving in an opposite direction. The hooks at the end of the spines of the bur thus caught the surface, and teased out much of the woolly fibre, giving it a velvety appearance; the cloth was then passed through a dressing machine, which pared down the irregular pile raised by the teasels, to a perfect uniformity of surface. In this way the nap of the cloth is still produced in other counties; each piece of broadcloth requiring at least 1500 burs to bring out the proper nap, after which they are useless. It appears from the construction of this frame that the teasels could be turned until each side had been worn down.

Many different kinds of cloth were teaseled in Norwich, including glove cloth, and after these mills had ceased to be worked here, the cloth woven in Norwich was sent away to be teaseled; the process was also employed to give an appearance of increased thickness to bombazine, by teaseling the back of the cloth. In addition to the rotatory motion, a slight side motion was sometimes given to the frames, just sufficient to prevent the teasels from

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catching the cloth in straight lines, and so making stripes on the goods; the cloth was always damped before being teaseled.

The teasel is still grown in the West of England, and large quantities are imported from France and America. The heads of the cultivated plant are not so large as those of many teasels growing in damp ditches in Norfolk; the object of cultivation being to strengthen the awns and produce heads of a uniform size. In England the seed of the teasel is drilled in April, and the plants are ready to cut in July of the following year; much care is needed in drying the heads.

The teasel was formerly of such importance as to have been borne as a charge on coats of arms, and a Norfolk surname has been derived from the plant.

Several attempts have been made to manufacture wire brushes which should supersede the teasel, but at present without success; the metallic hooks, if meeting a strong thread, are apt to tear it out, and thus do serious injury to the texture of the fabric, whereas the horny-hooked points of teasel give where necessary.

III.

ON THE FORMATION OF FLINTS IN CHALK.

By F. D. Longe.

Read 27th November, 1900.

In September last year, 1899, I happened to see in a local journal a short notice of a paper read by Professor Sollas, at the meeting of the British Association at Dover, on the formation of flints.

I gathered from this notice that he considered that a chalk flint was formed by the accretion of silica from the white coating with which flint nodules are covered when in their chalk matrix.

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I had a notion previously that flints grew or had grown by the accretion of silica from the chalk, and I set about getting further information on the subject.

I paid a visit to the Whitlingham pit, and collected some fragments of large flints covered with a white coating, as well as some of the smaller whole flints.

It occurred to me that if these forms were flint in an early stage of growth they would be represented by still smaller forms, and I soon learnt from the workmen that they often met with small nodules, apparently chalk, but which contained in the interior a small mass of black material like flint; and they had no difficulty in finding for me some half dozen of these nodules. Upon scraping off the white powder which forms the outside of the nodules I found that the black material in the interior was a small mass of flint like that of the larger nodules, and that these smaller forms only differed from the larger in the small proportion which the flint in the interior bore to the white powdery coating with which it was enveloped.

Having satisfied myself, by a process of examination which I shall explain shortly, what these nodules were, I sent a specimen of what I called an "Embryo" or "Baby" flint to Professor Sollas. He kindly replied, thanking me for my specimen, and informed me that "They are clearly what you suppose, incompletely formed flint."

Supported by this authoritative opinion as to the nature of my "baby" flint, I proceeded with my enquiry as to the relation between the black vitreous flint with the white powder in which it was embedded. Upon examining several specimens of small and large nodules, under an application of hydrochloric and hydrofluoric acids, the connection between the white coating and the black vitreous mass in the interior was very apparent.

The outer part of the nodules effervesced freely to hydrochloric acid and was evidently chalk, but as this acid was applied to the inner parts the effervescence gradually became less, and for a considerable thickness round the little flint in the interior the material did not effervesce at all.

I then applied hydrofluoric acid to the inner part of the coating; it at once showed slight signs of effervescence, and upon scraping off some of it and putting it into a glass tube with this acid it

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soon effervesced fiercely with much heat, and the quantity of the material sensibly diminished. The effect of this acid on this powder was precisely the same as its effect on some pure silica in another tube, and upon ground flint in another tube. The evidence of these tests are I think conclusive, the inner part of the coating, although just as white as the chalk on the outside, was silica; the same, or nearly the same, substance as the flint itself.

The relation between the coating and the flint inside appeared to be that the white powder next the flint in these nodules was silica in a granular state on its way to being converted into vitreous flint and added to the growing mass within. The nodules were flints in the process of formation, as Professor Sollas called them "incompletely formed flints."

An important point in the formation of flint, as shown in these nodules, is that it does not grow by the accretion of silica directly from the substance when in a free solution, as in the case of crystals, but of the accretion of silica from the granular silica with which it is immediately surrounded, and which must itself have been previously formed from silica in solution.

But doubtless there was and must be moisture to assist in the transition of the silica grains into massive flint. It would appear that the formation of a flint involves three processes and as many problems.

1. As to the presence of silica in a granular state in the chalk.
2. As to the process by which the silica is separated from the other substance with which it is mixed, and collected together.
3. As to the process by which it becomes converted into a hard mass of vitreous flint.

It appears from the literature on the subject to which I have had access that the formation of flint and other similar mineral concretions is as yet an unsolved problem.

With reference to the formation of flint, Professor A. H. Green, writing in 1876, says ('Geology for Students and General Readers,' p. 141):—

"We can only say . . . that the silica, which once pervaded *the whole rock*, has been separated out and gathered together into nodules; how this was done we cannot at present explain."

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In another passage he says (p. 174):—

"It has been observed in laboratory experiments that when different substances in a state of fine division are mechanically mixed together, certain of them do separate out and congregate together in nodular masses. . . . It is usual to speak of this as Concretionary Action. . . ."

It is clear that in both these passages Mr. Green is speaking of the substance of which mineral concretions are formed as mineral matter, not in complete solution, but in a *finely divided granular state*, and there seems to be good ground for his view that silica in this form is more or less abundantly disseminated in all chalk formations, except so far as it has been separated out and collected in concretionary nodules.

As to the origin of the granular silica in the chalk, there seems to be a general concurrence of opinion that its presence is due to the extraction of silica in solution in the waters of the cretaceous sea, by sponges, etc., and its deposition on the sea floor from the decomposition of these organisms.

In considering the problem of the separation of the granular silica in the chalk rock from the chalk and other mineral substances with which it is mixed, we may assume, I think, that the silica, though not in solution, was in suspension in the water which percolates the chalky mass, so as to be moved about with the water.

But what is the cause of its being separated from the other substances in the water and collected together?

This phenomenon would seem to imply the action of some *attractive* force bringing together particles of the same substance, to the exclusion or displacement of other substances with which it is mixed.

The attraction or cohesion of matter has been described as being analogous to the action of a magnet in attracting and holding iron in cohesion; but I have not met with any authority for attributing concretionary formations to magnetic or electric action. The force at work still lies hid in the great mystery of physical science—the problem which Newton left for future generations to solve—the problem of attraction of matter to matter, the manifestations of which are familiar facts of ordinary observation, as the cohesion of matter, the force of gravity, capillary attraction, etc.

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Whatever this mysterious force may be, it would appear to be acting in the same manner under different conditions in producing amorphous or spherical mineral concretions, as in the production of crystalline forms.

Sections of flint nodules often show bands of different colours or different shades of colours, particularly in their outer edges, which would seem to imply that the flint grew by the accretion of separate laminæ of material somewhat differently constituted, as to the other ingredients mixed with the silica, as, for instance, the proportion of oxide of iron contained. Indistinct lamination is also to be seen in the granular coating of some flints. This feature would seem to identify the formative process of flint with that of the agate, and of the spherical concretions which occur in both clays and limestones.

The tendency to form *globular* masses is a noticeable feature in the class of mineral concretions to which flint belongs, as distinguished from the prismatic and rectilinear forms assumed by crystals; though I believe many minerals—flint is not one—are found in nature both as prismatic crystals and as amorphous concretions.

The round flint concretions of our chalk pits are, in a few cases, the pebbles of our gravel pits, and sea beaches, which are generally very little altered in form or appearance since they were separated from their chalk matrix, in some not very distant geological period.

The conditions under which the flint grows and has grown in the chalk, precludes its being formed in regular spheres. But the spherical laminations so often manifested, and the rounded form of the nodules, show that they are formed under the action of the same forces which produce the more perfect spheres in chemical preparations. The young flint may maintain a more or less spherical form, but as it grows larger it has to adapt its form to the conditions under which it is supplied with material, or under which it can project itself into the solid chalk. Hence the curious tubercular forms assumed by the larger flints.

The spheroidal growth, and lamination of flints, show that they are not formed by the mere deposition of material under the action of gravitation, as in the case of tabular bands of chalk or other limestone. Gravity may play part in the supply of material, but

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it is the force which produces spherical lamination round a centre which is evidently the most important factor at work.

The process of the conversion of the loose granular silica, in the coating, into hard vitreous flint, would seem to imply the further action of the attracting and condensing force—which acting upon the granular silica whilst undergoing a slow solution in its moist matrix—draws it, molecule by molecule, into the solid mass within.

The manner in which flint is found enveloping or partially enveloping substances, would seem to suggest that the silica passed through a gelatinous state in the process of its accretion. Silica can be reduced to a gelatinous state in the laboratory, but I have no authority for suggesting that it has passed through such a state in the formation of flints in chalk.

In his account of the formation of flint, Professor Green makes no allusion to the silicious coating with which flints are covered, and I gather from Professor Sollas' treatment of the subject that this theory of the flint being formed from the silicious coating is new to science, and that it has been hitherto attributed to the decay of flints rather than to its growth.

In chalk pits, in the upper chalk, which comes to the surface in this part of Norfolk, flints abound in all shapes and sizes.

The formation and growth of flint nodules appear to have taken place *after the consolidation* of the chalk, and when it has been in much the same condition as we now see it; and it seems probable that the process of concretionary growth would continue so long as the flint remains undisturbed in the moist chalk, and is supplied with the materials requisite for its growth.

Flints are often found *enveloping foreign substances*, which are not uncommonly organic forms, such as sponges or shells silicified, and incorporated in the flint nodules, and which appear in some cases to have been the nucleus round which the flint nodules grew, and it has been thought that all flints have thus originated—as in the case of oolitic grains.

These foreign bodies are, however, often found in flint in such a position as to point to their having been enveloped by the flint as it grew. The notion that flints are all silicified sponge or other organic forms has been abandoned.

A not uncommon phenomenon is the presence of shells, echinidæ,

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or belemnites, partially enveloped in a flint nodule, but which, in some cases, have not *been silicified*.

I have a specimen of a belemnite half in and half out of a flint. The substance of the fossil is the same inside the flint as outside. It is an ordinary crystallised belemnite, and the substance is pure carbonate of lime (aragonite).

This belemnite must have been in this crystallised condition before it became partially enveloped in the growing flint. Relics of organic life, or other foreign substance, may provoke concretionary action; just as foreign substances provoke crystallisation, but they are not necessary to the origin of a flint or any other mineral concretions. They are common as curiosities and freaks, rather than as representative of the normal growth of flint. However they originated, the formation of flint concretions has apparently been to extract and gather together the silica disseminated through the chalk, so as to reduce the material of the "upper chalk" formation to a much purer carbonate of lime than that of other chalk formations.

The flint nodules in Norfolk chalk pits may be classed in three groups.

(1) The larger, or, as I would say, the full-grown nodules, are generally of tuberculous or knobly forms, and are found lying in horizontal lines about eight to ten feet apart.

These larger flints have generally a very thin coating of silicious material if any; the granular silica having been all absorbed in the flint.

The arrangement of these large nodules in horizontal layers would appear to be due, in part, to the action of gravity in bringing down the granular silica, as in the formation of layers of chert.

(2) Another class, and by far the most numerous, are the smaller forms, round or egg-shaped, sometimes long finger-shaped nodules. These are found distributed apparently without any system or regularity between the layers of large flints. This class includes the "baby flints."

These whole flints are always more or less round, and the surface is similar all over the pebble. It is generally of a bluish colour (except when stained by peroxide of iron), and shows markings or indentation, which belong to the original

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surface of growing flint, where the consolidation of the granular material is not so complete as in the interior.

(3) Another and more exceptional class are the huge pot stones or "paramoudras," as they have been called.

These masses are apparently formed of pure black flint, like that of the smaller nodules, and to have been formed by the same concretionary action.

They generally have tubular hollows, which, when undisturbed in the chalk, are filled up with chalk, or silicio-cretaceous material like the coating of the smaller nodules.

These columnar masses would seem to be merely large concretions formed in sinks or perpendicular lines of drainage, made by water gravitating down, but only partially hollowing out the chalk. These pipes furnish larger cavities for the accumulation of water, than those in the more compact chalk around them. The larger quantity of water percolating through these sinks has caused a larger accumulation of silica, and the growth of larger concretions.

The dimension and forms assumed by the various flint nodules would seem to be due to the quantity of silica brought within reach of the concretionary action. Each nodule appropriates the silica with which it is environed, and when that is absorbed the further growth of the nodule ceases.

This would seem to explain the different sizes, as well as the different forms of flint, and would also account for the scarcity of very small nodules now to be formed. Assuming that flints were formed since the consolidation of the chalk, the conditions requisite for their growth may have long since ceased to prevail. Even the "baby flint" was not born yesterday.

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IV.

ACULEATE-HYMENOPTERA AT TOSTOCK, NEAR BURY ST. EDMUNDS.

By W. H. Tuck.

Read 27th November, 1900.

The season of 1900 will be certainly remembered by entomologists as one of unusual interest. Probably never before have so many workers been out, and so many good things come to light. Although the weather was at times broken, I managed to put in over seven weeks of field work, and explored several fresh localities.

Beginning with Aculeate-Hymenoptera, I added four species to my local list:—

Formica cunicularia, Ltr. A worker, October 1st, near the Mill Heath, Rougham, beaten from the dense undergrowth at the base of a Lime-tree.

Pompilus plumbeus, Fab. October 2nd, same place, sitting on a sandy bank; it allowed me to "box" it quite easily.

Tiphia femorata, Fab. August 26th, upon Angelica bloom. Both this and T. minuta were rather abundant this season.

Andrena niveata, Freese. Three queens in June and July upon Parsley. This is a new species recently added to the British list by Mr. E. Saunders, probably overlooked, and mixed up with A. nana.

At Brundall, in August, I took Odynerus antilope, our largest solitary Wasp. It was flying round the reed-thatching of a summer-house. This species has only once before been recorded for Norfolk by Mr. Atmore of Lynn.

Near Coldham Hall I found Prosopis brevicornis, and Halictus punctatissimus, one of the rare Halicti, and at Blofield Andrena nigriceps on Thistle blooms.

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The most interesting capture to my mind among the Aculeates was one of the large family of Ichneumonidæ (sub-order Chalcis), Smicra sispes. This singular insect is figured and described by W. F. Kirby in vol. xv. of the 'Entomologist,' and may be known by the enormous size of its hind femora. The whole of the interesting order of Ichneumonidæ are parasitic, attacking the larvæ of Lepidoptera, Coleoptera, and Sawflies; also Spiders and the grubs of Diptera. In this case Chalcis is parasitic upon the large water-fly Stratiomys, of which we have several species. The grubs, when full-grown, leave the water to pupate upon the plants above, and are then attacked by the parasite. Both the sexes of Smicra sispes are fond of the Angelica blooms, which grow near the spot they emerge from.

In Coleoptera the best thing by far I had was the Longicorn, Phytœcia cylindrica, which is said to be bred in old Willows; very few collectors have seen this beetle alive. I also took Leptacinus parampunctatus, which has not occurred since Stephens recorded it in the thirties, and Silpha littoralis, which is last heard of in 1862.

I again record Megarthrus affinis, and Homalium pygmæum, as only again occurring at Tostock, also Choleva Wilkini (new to the Suffolk list), and the very local Stenus binotatus. At Lowestoft the glossy "skipjacks," Phyllotreta cruciferæ, were abundant in a market garden near the North Denes, and at Ditchingham (a good centre) Coccinella 14-guttata. Upon Mousehold I took two specimens of that rare Dipteron, Myopa fasciata, which looks like a Crabro when at rest upon a flower. At Bungay the fine Trixa æstroidea, and at Lowestoft the plumed-fly Anthrax paniscus, both I believe new to Suffolk.

Sawflies were unusually abundant in the early summer, one new to the list, Emphytus grossulariæ; also Abia sericea, and Hylotoma gracilicornis (Lowestoft). The most striking of these is the Abia, which is not uncommon if searched for near the river in wet places. The best capture in Hemiptera was the fine Reduvius personatus, which flew in to "light" in early summer.

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V.

ON SOME CRANES' BONES FOUND IN NORFOLK.

By Professor Newton, F.R.S.

Read 29th January, 1901.

In August last when this Society honoured Cambridge by a third visit, Mr. Southwell brought with him, and left in my charge, three bones belonging to the Norwich Museum and attributed to the Crane (*Grus communis*), asking me to compare them with specimens in the University Museum of Zoology, and to communicate the result to the Society. I need scarcely say that I willingly undertook so grateful a duty, and now comply with the request of my old and valued friend.

I understand that these bones had long been in the Gunn Collection of the Norfolk and Norwich Museum, and that, though their history has not been recorded, they were found in excavating the Alexandra Dock at Kings Lynn, between the years 1867—1869. Their dark colour shows that they have been imbedded in peat, but there is nothing to indicate their antiquity. There is no doubt of their having been rightly assigned, and they are two right *tibiæ*—neither having the epicnemial process perfect—and the greater part of a right *radius*, of which the distal extremity has been broken off. The two tibiæ differ remarkably in size, the length of the smaller one, from one articular surface to the other, being only 10·1 inches, while that of the larger, measured in the same way, is as nearly as possible 12 inches—the longest specimens in our Museum (Burwell Fen, 1897, Reg. No. 344 BA) measuring from the same surfaces 12·25 inches, and another (Burwell Fen, 1876, Reg. No. 344 C) 11·25 inches. I had long been aware of the difference of size observable in ancient English Cranes' bones, and I had set it down to difference of sex; but I was hardly

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prepared to find it so great as the figures above show. I cannot, however, otherwise account for it, for no question as to a second species ought to arise, and the state of the bones forbids our deeming it due to age.* The imperfect condition of the radius leaves it somewhat uncertain whether it belonged to a bird of the larger or the smaller size; but I incline to think it was the former.

I may add that my Woodwardian colleague, taking an interest in the enquiry in which I was engaged, kindly allowed me to look over all the birds' bones from the Fens in our Geological Museum, among which there are some thirty Cranes' bones or more, referable perhaps to half a dozen individuals. The Museum of Zoology is not quite so rich, and contains but twenty-seven, which seem to be the remains of but two birds. In the course of the examination of the bones submitted to me by Professor Hughes, another Pelican's bone, a right *tarso-metatarsus*, revealed itself (No. 49). This, from its colour and condition, seems to have come from the same deposit as the first *humerus* (No. 25) that was discovered, as formerly mentioned to you by your President (Trans. Norfolk and Norwich Nat. Soc. vol. vi. pp. 363, 364). Comparison with the corresponding bone of *Pelecanus crispus* confirms the opinion I have long entertained as to that having been the species which was once a native of our Fen country.

* The difference is not peculiar to old English Cranes; but, though overlooked or cursorily mentioned by most writers, it is properly dwelt on by some of the best continental authorities. Thus Naumann ('Vögel Deutschlands,' vol. ix. p. 346) gives for the whole length (excluding the bill) of the males, 4 (Rhenish) feet, and of the females, 3 feet 6 inches. Nilsson, who goes into further detail ('Skandinavisk Fauna, Foglarna,' ed. 3, vol. ii. p. 159), puts the tarsus of the ordinary male at 10 (Swedish) inches, while he notices exceptions of 9 and even 8·5. Here the difference of the extremes it will be seen is 1·5; but that is much less than the 2·15 shown by the Norfolk specimens, and I think the sexual explanation is needed in their case.

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VI.

ON THE BREEDING OF THE CRANE IN EAST ANGLIA.

By Thomas Southwell, F.Z.S., V.-P.

Read 29th January, 1901.

There is no bird, with perhaps the single exception of the Bustard, possessed of greater interest to the East Anglian Ornithologist than the Crane, and to a large extent the claims of both these fine birds to our special regard are due to similar circumstances: both were the largest of their kind inhabiting Britain; the one was the greatest ornament to the wild uplands, and the other graced with its stately presence the all but inaccessible fens, which in times past formed the chief feature of a vast tract of country, comprising parts of the counties of Cambridgeshire, Lincolnshire, and Norfolk. The Crane was above all the grandest quarry of the Falconer, and nothing less than the largest of all Falcons, the Gyrfalcon, could be successfully flown against it; added to which no royal feast or civic banquet was complete without the Crane, (too often accompanied by the Bustard,) appearing amongst the chief dishes at the abundantly furnished tables. Many such banquets are on record, and it is mainly to culinary estimation that we owe most of the surviving information with regard to this bird as a former inhabitant of the British Isles.

The investigation of the history of the Crane as an inhabitant of East Anglia would, doubtless, amply repay the labour involved in searching the records existing in the muniment rooms of public bodies, especially those preserved in such towns as Lincoln, Boston, Cambridge, Ely, and Norwich, and in the household accounts of

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the old County families and great religious houses so plentifully scattered throughout the great level of the Fens. But for this purpose special gifts are required, and the skill necessary to decipher such documents, as the writer has amply experienced, is not easily acquired. The chief reason for my putting these notes together, in which there is otherwise little that is new, is an interesting fact which has been brought to my notice by Mr. J. C. Tingey, F.S.A., the custodian of the corporation muniments in this city, who most kindly, in response to an expression of my hope that he would take note of any entries of interest to ornithologists he might discover in the ancient documents under his charge, pointed out to me certain entries with regard to expenditures made by the corporation authorities in the purchase of Cranes as presents to the Duke of Norfolk and others, one at least of which I think is of the greatest possible interest, seeing that it establishes beyond question the fact of the Crane having in times past bred in the neighbourhood of Norwich, and in a locality which, although perhaps as rich then, and long after, in fen-loving birds as any such like district in the kingdom, was absolutely unknown to naturalists before the beginning of the century which has so recently closed upon us. But before speaking of this, it may be well to give a brief epitome of the references to this grand bird in past times, and to trace, as far as possible, the history of its extinction as a resident or regular visitor to this country; and let me here express my indebtedness in this respect to the valuable article by Mr. J. E. Harting, in the 'Field' of the 23rd of December, 1882 (vol. lx. p. 890), in which he has brought together many very interesting references to this bird to be found in various old records difficult of access.

The earliest mention of the Crane as an inhabitant of Britain, I believe, occurs in a letter from Ethelbert II., Saxon king of Kent (who died in the year 760), to Boniface, Bishop of Mayence, and is due to the king's love of Hawking, for he asks the Bishop to send him over two Falcons suitable for flying at Cranes in Kent; it is also recorded that King John in pursuit of this royal sport flew his Gyrfalcons at Cranes so successfully that in December, 1212, at Ashwell, in Cambridgeshire, he killed seven, and on another even more successful occasion in Lincolnshire in February, 1213,

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he brought down nine of these fine birds, whereat the king, as in duty bound, was greatly pleased. In 1298, Edward I. received three Cranes also killed with the Gyrfalcon in Cambridgeshire. These early records all refer to the Crane from the sportsman's point of view, and indicate the esteem in which it was held as the noblest quarry at which, in this country, the Falconer could fly his Hawks; but the next record is of a very different character, and although it shows that the Crane at that time frequented this country in considerable numbers (for we can hardly imagine they were imported from the Continent), it has a melancholy import as foreshadowing the inevitable result of such wholesale slaughter, for we are told by Leland, in an oft-quoted passage, that at the enthronisation of Archbishop Neville, in the reign of Edward IV. (1461—83), two hundred and four Cranes were included in the bill of fare at the grand banquet which followed. Cranes are also mentioned in the Household-book of the fifth Earl of Northumberland in 1512, as desirable to be had for my Lordes own mees at Christmas and other principal feasts, "so they be boght at xvj d. a pece;"* and this brings us to our own county, and to an important era in the history of the Crane in East Anglia.

In the muniment room at Hunstanton Hall there exists a record of "the Household and Privy Purse Accounts" of the ancient family of the Le Stranges, kept during the years 1519 to 1578, a transcript of which was communicated to the Society of Antiquaries by the late Mr. Daniel Gurney, and was printed in the 25th volume of 'Archaeologia,' p. 529 *et seq.* Here there are five entries referring to Cranes between the years 1519 and 1533. The first entry in 1519 is merely in the following words: "Itm. pd. for a Crane and vi. Plovs xx d.;" the second refers to a Crane sent in with other provisions as "of gyste," or in lieu of rent; the third, in December, 1526, is stated to have been killed with a crossbow; for the delivery of the fourth, in September, 1533, a reward of vj d. was paid; and in December of the same year we meet with the last entry as follows: "Itm. a Cranne kyllyd w^t^ the Gun."

Hitherto the wild birds and beasts had only the hawk, the snare, and the cross-bow to contend against, but a new era had dawned with the introduction of the gun, and although perhaps the evil

* Northumb. Househ. Bk. p. 104.

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arising from its use arose at first more from the noisy disturbance caused by its unwonted explosions, than from its deadly effects, still the mention of such birds as the Water Hen, the Mallard, and the Wigeon obtained by its means shows that it was used with some degree of success, and it is probable that from hence dates the more rapid extinction of the Crane in Britain, notwithstanding an attempt about this time to afford it protection by partial legislation, a fact which, in itself, points to the imminence of the danger.

We now come in chronological order to the records in the Chamberlain's accounts of the City of Norwich. The first which Mr. Tingey found—although doubtless farther search would discover others both before and after—occurs in the year headed 1531—2, and I am sorry not to be able to give the exact date, for the accounts run from Michaelmas to Michaelmas, and appear to be entered in batches, the precise month or day being rarely given. At folio 34 occurs the following:—

Payed for present to Duke of Norfolk.

In Primis To Mr. Rogers to iiij Swannys .	xvj s.	
and for the hokeng* of them . .		1d.
and for ij Cranys	vj s.	viij d.
and for a man & an horse a daye to seke Cranes		xij d.

There was also paid at the same time for a present to the Duke of Suffolk for four Swannys xvij s iiij d two Cranes vj s viij d six copill of Malardys iiij s.

The four Cranes above mentioned may have been the result of the journey made by the man who was sent out to "seke them."

Another entry under date of 1532—3 is as follows:—

Present to Duke of Suffolk.

Palmer for a Swan	iiij s.	iiij d.
and for a Swan bought in the Market .	iij s.	iiij d.
and to Master Litilprowe for a Swan ij elys and iij Cranes . . .	xx s.	ij d.
and Payed to Worlyngton for Cariage of this Present to Westhorp in Suffolk .	vj s.	viij d.

* Catching them with a Swanherd's crook.

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In 1542—3 Fol. 71.

Itm.	To Osborn of Kyrby for vj fatte Swannes	xviij s.	
Itm.	For fechyng of them from Kyrby .		iiij d.
Itm.	For kepyng of them vj days after .		xij d.
Itm.	For a closse Mawnde* to trusse them in		vj d.
Itm.	Payd for a Purpose Pygge govyn to his Grace at hys fyrst comyng at Mr. Rede's howse than Mayer . . .	vij s.	vj d.

The latter formed part of a present given to the Duke of Norfolk then at Kenninghall.

1544—5 Fol. 174.

In Primis Pd. for a Present send to the Duke of Norff. his Grace to Kenyngale the xxix day of Novembyr within the tyme of thys accompt and ffyrst to Robt Osborn of Kyrby for vj fatte Swannys . .	xxiiij s.		
Itm.	To Thomas Palmer for ij Cranys .	xij s.	viij d.

I shall quote one more entry from this source farther on, but at present my object is to show that in the 16th century the Crane was apparently by no means a rare British species, although it did not much longer continue so. About this time we also have Dr. Turner's statement in his *Avium Historia* (1544), that he met with Cranes probably in Cambridgeshire, to which we shall again have to refer.

By letters patent, dated August 1554, 1 and 2 Philip and Mary, license was granted "unto our wellbelovyd subjecte George Eden," who seems to have resided partly in London and partly at Sudbury, and to have had a landed estate at Wickhambroke, in Suffolk (to which county, according to the same Patent Roll, he was in 1555 appointed surveyor of Crown lands),† "to appoynte at his wyll and pleasure any one of his servauntes to shote in a crosbowe or handgone att all manner of dere, heron, shullard (*i.e.*, spoonbill), wildswane, mallard, tele, *crane*, bustard, and all other land fowle or water fowle whatsoever, and also to use, carrye, occupie, and kepe his said crosbowe or handgonne for the purpose aforesaide within the counties of Suffolk and Cambridge, and the lymyttes of the same."

* A covered basket to pack them in.

† Dr. J. J. Howard, 'Visitation of Suffolke,' 1866, p. 17.

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On the 27th November, 1563, John Repps writes from 'Walpole in Marshland,' to Bassingbourn Gawdy,* stating that he "sends a Crane with two Mallards, which is all the fowl they can get, it is so scarce," and adds by way of excuse that, owing to the late storm breaking their banks, the "fowlers have no leisure to lay for fowl," which may in a measure account for the apparent scarcity, for on the 3rd of November, 1567, Mr. Balam was able to send nine Cranes, with many other wild birds, out of Marshland in Norfolk, as a wedding present to a lady in Sussex, showing that wild-fowl must still have been numerous in that locality.†

Dr. Muffet in his 'Health's Improvement,' probably writing about the year 1595, damns with faint praise the flesh of the Crane even when young, but when adult, stigmatises it as "hard, tough, gross, and sinewy."

Michael Drayton in his wonderful description of the Lincolnshire Fens, to be found in the 25th Song of his Poly-olbion, published in 1622, but probably written about the year 1598, dismisses the Crane with one line, but that full of poetic vigour:—

"There stalks the stately Crane, as though he marched in war,"

showing that this noble bird was no stranger to him.

In June of the year 1663, the Mayor of Norwich entertained the Duke of Norfolk and the Hon. Henry Howard, and it was probably to that occasion which Sir Thomas Browne refers, when he makes the oft-repeated and as often mis-quoted statement, "I meet [not met] with Cranes in a dish," and adds, that although often seen here in hard winters they seem to have been more plentiful.

Willughby, in his 'Ornithologia' in 1678, states that at that time the Crane still came "often into England, and in the fen countries, in Lincolnshire and Cambridgeshire, there are great flocks of them," but whether his information was of the latest I think seems rather doubtful, for although Ray repeats the statement in the *Synopsis avium* (1713), Pennant in the Appendix to his 'British Zoology' (1768), with reference to this, remarks, "on the strictest enquiry we learn, that at present the inhabitants of those counties are entirely unacquainted with them; we therefore

* *Vide* Hist. Manuscript Com. Report on MSS. of the Family of Gawdy, p. 5; and Trans. Norfolk and Norwich Nat. Soc. vol. vi. p. 249.

† 'Archæologia,' vol. xxxvi. p. 36.

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conclude, that these birds have forsaken our island." And so this noble bird, which had been an inhabitant of Britain from time immemorial, became extinct as a resident, the victim probably to persecution rather than to natural causes, and we at present know it only as a rare and occasional visitor, a mere wanderer to its former haunts straying from its accustomed line of migration.

From the frequency with which Cranes were met with here in the months of November and December, at which time one would have imagined that they were enjoying the milder climate of Northern Africa, the species would seem to have been a winter resident in the fens; but in attempting to form an estimate as to its abundance, or otherwise, in Britain in times past, it is well to bear in mind that this bird is one of the most typical of migrants, and although Willughby writes of the large flocks visiting the fens of Lincolnshire about the year 1678 (a statement on which I have already commented), these flocks may have consisted merely of passing migrants which had halted on their journey south to rest and recruit; on such exceptional occasions, no doubt, considerable numbers might have been obtained, thus conveying to us the impression that they were exceedingly plentiful, although it may be doubted whether such was really the case generally. The visits of these flocks would almost certainly be restricted to very limited areas in a few favoured localities, thus creating a temporary abundance, but their stay would probably not be of long duration. Those which bred with us would at that time be in solitary pairs, arriving in spring and later on departing south, accompanied by their young. I doubt, therefore, whether the Crane, except perhaps in very remote times, was ever a common bird in Britain, and the high price invariably paid for them would seem to confirm this impression.

With regard to later mention of the Crane it is needful to use caution, for, as has been pointed out, it seems to be the fashion for an expiring species to bequeath its name to some other that more or less resembles it, and it is possible that in some instances the Heron may have inherited that of the Crane; but there is generally some circumstance which will enable one to detect this substitution, such for instance as the price charged, or the mention of both species in the same record, leaving no room for doubt; but in this respect I do not think I have erred.

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Previous to the discovery by the late Mr. John Wolley of the nesting haunts of the Crane in a marsh in Swedish Lapland, little appears to have been known as to the nesting of this bird by continental, and nothing whatever by British Zoologists; the eggs said to be those of the Crane in collections here were without authentication, and strange as it may appear, in the case of a bird now known to breed in Spain, North Germany, Russia, and Scandinavia, we are indebted as already mentioned for the first authentic account of its nesting habits to Mr. Wolley, whose charming narrative of the event appeared in the first volume of the 'Ibis' (pp. 191—198), and which picturesque description cannot be read without a thrill of delight and of admiration for the true spirit of the naturalist displayed on the occasion. A perusal of the accounts given in books of an earlier date will, on comparison with Wolley's graphic description, show to what an extent they were due to their author's imagination.

It was on the 15th June, 1853, that Wolley entered the dreary Lapland marsh, and after a brief search discovered a nest containing the remains of two eggs, which had recently been hatched, and saw in the distance a Crane; soon another Crane was seen, and shortly after, for the first time for centuries,* an English naturalist looked upon two young Cranes in their first clothing of down. Here surely was an opportunity of acquiring a valuable "specimen," for the condition of the young Crane on first leaving the egg was quite unknown, and had given rise to much speculation, as it would afford valuable aid in determining the true position of the genus which had generally been associated with the Herons—who could refrain from sacrificing the little one in the cause of science! Listen to what follows: "As I fondled one of them it began to peck playfully at my hands and legs, and when at length I rose to go away, it walked after me, taking me, as I supposed, for one of its long-legged parents. I had only just before been plucking from it some bits of down to keep, for valuable as I knew it to be in a natural history point of view, I could not make up my mind to take its life. As soon as I saw its intention to follow, I took to double-quick time and left it far behind . . . . . As we went away I saw one of the Cranes alight where we had left the young one. Later in

* It is possible that Dr. Turner may have had this experience—see below.

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the day I had a longing wish to have another look at my young friends. I thought the old naturalists would have called them 'Peepers.' . . . To see them twice in a life would be a consolation, but it was not to be," both young and old had gone. He had other opportunities however of studying the nesting habits of the Crane.

It is however to the nesting of this bird in Great Britain I wish particularly to refer, and of that there is little enough positive evidence, although there is more which is indirect. The earliest record with which I am acquainted happens to be the most circumstantial, and fortunately refers to our own County of Norfolk. In the City Chamberlain's accounts, before referred to, under the date of 1542—3, and the sub-heading of "The morrow after Corpus Xti' day," which I am informed fell in that year on the day corresponding with the 4th of June of our present reckoning, occurs the following entry:—

Itm. pd to Notyngham of Hyklyng for a yong Pyper Crane	v s.	
and for caryage to Norwich . .		iiij d.
to Edmond Wolcey for an other Crane .	v s.	
	= x s.	iiij d.

The above formed part of a present to the Duke of Norfolk, then at Kenninghall, and from the time of year, and the express mention of a "yong Pyper Crane," there is no room for doubt that in the year 1543 the Crane bred at Hickling. There are other entries which seem to point in the same direction, especially that quoted at p. 163 when 12d was paid for a man & horse "to seke Cranes," for although I find it impossible to fix the precise date of this entry, it appears, I think, highly probable that they were young Cranes of which he went in search.* The instances, too, where Cranes are mentioned associated with fat Swans, which we know were only eaten in the cygnet stage, seems to me strong presumptive evidence that they also were bred in the neighbourhood.

The instance just quoted is, so far as I know, the most precise record extant of the Crane breeding in Britain, and I am exceedingly glad that it should refer to our own County, and to a locality which up to a very recent period has retained much of its original wildness,

* Mr. Gurney suggests that the horse may have been used as a stalking horse, behind which to approach the Cranes.

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and long continued to be the home of some of our most interesting aquatic birds, after they had disappeared from localities better known to the older naturalists.

It is evident that in 1534 alarm was excited at the decrease of the wild-birds valued for food, especially of the Crane and the Bustard, for in that year an Act was passed "against the destruccyon of Wylde Fowle" by which a penalty of 20d. and one year's imprisonment might be inflicted for the destruction, purloinment, withdrawal, or taking from any nest the eggs of the two birds named, with lesser penalties for those of certain other species of wild-fowl. This Act was carefully drawn, and Crows, Choughs, Ravens, and Bustards were specially exempted from protection, together with "any other fowl or their eggs not comestible nor used to be eaten."

The next reference to the breeding of the Crane in England, and until the Hickling record was brought to light, the only positive statement on the subject I have met with, is that of Dr. William Turner, in his *Avium Historia* (Coloniæ, 1544), who although a native of Northumberland spent fifteen years at Cambridge, and was doubtless well acquainted with the birds of the Fen district. His statement is very precise that they bred in the marshy districts, and that he had very frequently seen their "*pipiones;*" this experience was most likely gained in the Cambridgeshire fens.*

It is quite evident that towards the end of the sixteenth century the Crane was growing scarce, and I know of no further reference to its breeding in East Anglia. Dr. Muffet, in his 'Health's Improvement,' before referred to, probably writing in 1595, does not speak of their breeding from his own experience. His words

* Turner's book is very rare, but Prof. Newton, who is the fortunate possessor of a copy, has kindly furnished me with a verbatim extract, which is as follows: (the book is not paged, but it occurs on what would be pp. 77 and 78) "Vipiones Plin. dicuntur minores grues & iuniores, [In margin "Pipers"] ut pipiones iuniores dicuntur columbæ. Apud Anglos etiam nidulantur grues in locis palustribus, & earum pipiones sæpissime uidi, quod quidam extra Angliam nati, falsum esse contendunt," which may be thus rendered: "Smaller and younger Cranes are called Vipiones by Pliny, as younger Doves are called Pipiones. Among the English also, Cranes nest in marshy places, and I have very often seen their Pipers, which thing certain men born out of England maintain to be false."

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are (p. 91): "Cranes breed (as old Dr. Turner writ unto Gesner) not only in the northern countries among the nation of dwarfs, but also in our English Fens . . . . Certain it is that they are of themselves hard, tough, gross, sinewy . . . . yet being young, killed with a Goshawk, and hanged two or three daies by their heels, eaten with hot galentine, and drowned in sack, it is permitted unto indifferent stomachs." He may, however, have had in his mind home-bred Pipers when describing their esculent qualities. It is even possible, although less probable, that the Cranes which graced the feast given in honour of the Duke of Norfolk in June, 1663, before referred to, may have had a local origin. Certain it is, that when the Crane was no longer successful in rearing its young in this country, its extinction must rapidly have followed, and although the members of the native race probably returned to the place of their birth so long as any of them existed, with the dying out of these indigenous birds would doubtless cease the annual visits of this species to East Anglia, a process of extinction precisely similar to that which in our days we have regretfully witnessed with regard to the Ruff.

I have thus endeavoured to trace the extinction of the Crane in this district as a resident or as a regular summer visitor, as well as to record what is known of it as breeding in East Anglia, and I trust the discovery of the interesting fact of its having nested so near to this City, may be accepted as the one fact extenuating the poverty in other respects of this communication. I will only add that the last appearance of this grand bird in Norfolk was in April, 1898, when a flock of four were seen on two or three occasions in the neighbourhood of Cley and Runton, resting on their spring migratory journey, and I am proud to add that, to the honour of Norfolk ornithologists, they finally departed unmolested.

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VII.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1900.

By Thomas Southwell, F.Z.S., V.-P.

Read 26th February, 1901.

Could the Committee of Management which at their First Annual Meeting on the 25th October, 1825, under the presidency of Sir James Edward Smith, "adverted in terms of high satisfaction to the very considerable prosperity of the Museum . . . . which had been constantly and rapidly increasing in public favour and estimation," but visit the present succession of bright and beautiful galleries filled with choice specimens, they would indeed be gratified at the results of their initiative, and share the satisfaction felt by the members of the existing management, some of whom have for many years watched the continued steady progress of the Institution, despite the many difficulties with which it had to contend; these are now happily things of the past, but the growth of the collections continues undiminished. When the scheme for the conversion of the Castle buildings to their present purpose was first considered it was not contemplated to provide a gallery for a collection of Pictures, then virtually non-existent; but happily wiser councils prevailed, and in less than seven years the present Picture Gallery has been filled with valuable works of art, and the committee are contemplating its immediate extension at a considerable cost.

The year just brought to an end has witnessed the erection of a gallery in the Fossil Room, rendered necessary by the very extensive additions to the Mammalian remains, almost all of local origin, which entirely fill the lower wall cases, those in the gallery being devoted to a stratigraphical collection now in course of arrangement. This extension has been rendered necessary by the liberal gift by Mr. Russell J. Colman, of the fine collection of Mammalian remains

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(including the collection made by Mr. Randall Johnson) belonging to his late father, and formerly kept at Corton. This has been incorporated with the "Gunn" and other collections, and the whole forms a display, probably unequalled in any provincial museum. Several other additions have been made in this room, which it is hoped will not only render it more attractive in appearance, but will be found possessed of educational value, and prove instructive to visitors and students by showing the relatively gigantic size of some of the extinct animals, whose remains are contained in the cases, as compared with their representatives now living. The chief of these are the heads of a recent African Elephant, and of a European Elk, with a large diagram of the skeleton of the extinct *Elephas meridionalis*, and full-sized drawings of the bones of the fore-leg of this and of a recent African Elephant.

To our valued friend Dr. Charles Hose we are indebted for a fine adult specimen of the Orang Utan (*Simia satyrus*), and a Müller's Gibbon (*Hylobates mülleri*) from Borneo, and to Mr. T. O. Springfield for an immature and two adult Wild Cats (*Felis catus*), the former from Inverness and the latter from Ross-shire.

It becomes more and more difficult to add new species to the collection of Raptorial Birds, but Mr. Gurney lets no opportunity pass of securing desiderata in any form; in the past year he has only been successful in obtaining one new species, but that is of considerable interest. He has been good enough to send me the following notes with regard to the Birds of Prey:—

"Of the four well marked species in the Neotropical genus, *Leucopternis*, which were desiderata at the time of my father's death, it will be remembered that we obtained one, *L. semiplumbea*, some eight years ago, and so seldom are these birds brought to this country that it is only now through the instrumentality of Mr. Rosenberg, the natural history agent in London, that we have secured another species. This is the handsome *L. plumbea* of Ecuador and Panama, and the voucher on the ticket is 'Rio verde, Ecuador, 3200 feet, 28th November, 1899, male, iris dark red, feet orange, bill dark bluish grey.'

"The thighs in this skin are not nearly so white as in the plate accompanying Mr. Salvin's revision of this genus ('The Ibis,' 1872, p. 239), but in other respects it agrees well, except that the eyes in the plate are of the wrong colour. This *L. plumbea* (ours is evidently

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an adult) is a fine species, and the best addition to the Raptorial collection for some time.

"Another specimen of *L. plumbea* subsequently sent from Ecuador to Mr. Rosenberg showed some immaturity, the thighs and flanks being conspicuously barred with white, and the belly and lower breast less so; it had been killed in May and was marked a male, and I am much obliged to him for sending it for inspection."

"A female *Spiloglaux* (*Ninox*) *ocellata* (H. and J.) from Cook Town, Queensland, labelled '20. vi. 97,' presented by Mr. Reeve, with some other birds, not raptorial, a smaller and more rufous species than the common Australian *S. boobook*, is the only Owl for the year. Several Owls of this family have been added to the Museum since the printing of the Raptorial catalogue in 1894, but there are still some desiderata, *e.g.*, *S. rosseliana*, which is much smaller than *S. boobook*, and *S. albaria*, inhabiting a single island on the east coast of Australia, and *Ninox obscura* from the Andamans, figured in 'The Ibis' (1874, p. 129), by Lord Walden."

Dr. Charles Hose, whose liberal contributions from Borneo, New Guinea, and Celebes, we have so often acknowledged with gratitude, has further enriched the general collection of birds by the gift of eighty-four skins of choice species from the above localities; and Mr. George H. Raw has presented us with thirty-three skins, including twenty-four species of birds from Natal. Mr. Reeve's gift of *Spiloglaux ocellata* has already been mentioned, and we are also indebted to him for examples of *Myzomela obscura* and *Graucalus melanops* from Queensland. The Zoological Society has also been good enough to send us a specimen of the South American Rufous Tinamou (*Rhynchotis rufescens*). These constitute the principal additions to the Ornithological collections.

An interesting fish known as the Black Fish (*Centrolophus pompilus*), the first specimen which has been met with on the Norfolk coast, taken on Palling beach in March, 1898, has been kindly presented by the Rev. A. Garway Atkins.

Numerous additions have been made to the Mineralogical Collection, now in course of arrangement, and about 250 species of Miocene shells from Touraine, France, have been purchased. Mr. Gurney has presented a cast of the skull and mandible of the remarkable gigantic extinct bird, *Phororhacos longissimus*, from the Tertiary deposits of Santa Cruz, Patagonia.

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In the department of Ethnology Dr. Hose has also been a benefactor to the Museum, having contributed twelve examples of Native Arms and Domestic Implements from Baram, in the district of Sarawak, Borneo. Other native productions from Fiji and Queensland have been added, which are particularly acceptable, as the greatly increased intercourse with these peoples is rapidly rendering genuine relics of their primitive savagery scarce and difficult to obtain.

The Library also has been in receipt of numerous and valuable additions, among the chief of which are eighty-eight volumes on Natural History, and other publications from the Trustees of the British Museum, and a number of books from the U. S. National Museum and Department of Agriculture. Mrs. Bridgman has also added eighteen volumes to the Entomological Library of the late Mr. Bridgman, which was presented with his valuable collection of Hymenopterous Insects a few years ago. These only form a portion of an unusually long list.

109,228 persons passed the turnstiles during the year 1900.

VIII.

SOLAR HALO AND MOCK SUN.

By C. B. Plowright, M.D.

Read 29th January, 1901.

On the afternoon of Saturday, 22nd December, 1900, I had the good fortune to witness the above phenomena, a short account of which may be of interest. In the first place, solar haloes are not very uncommon, but they are more frequently observed in and around London than with us. This may be due in part to the greater number of persons dwelling in the metropolitan area than in the more sparsely populated county districts; but it is more

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likely that the number of days in which there is more or less fog has something to do with it. In order to see a solar halo the sun must not be too bright, otherwise the observer cannot look at it. On 25th May, 1894, a fine solar halo was seen in Lynn. About 11 a.m. it was very readily seen by the naked eye; at 1.45 it could be seen, but it was not then so bright as to have attracted general attention, in fact it had to be looked for. An hour later it could be seen only by looking for it through a smoked glass, and was obvious enough then, and could be seen late into the afternoon. On a subsequent occasion my friend Mr. D. C. Burlingham called my attention to a solar halo, but by the time he reached my house it could not be seen, except through a coloured glass, the brightness of the sun overpowering it.

On the 22nd December, 1900, at about 1.45 or 1.50 p.m., my son, Mr. C. T. M. Plowright, and myself saw, as we were riding up Shouldham Thorpe Hill, a very bright solar halo, which measured roughly 45° across. Owing to the low position of the sun in the sky at this season it did not form a complete circle, the lower third, or perhaps less, being invisible. In about fifteen or twenty minutes the halo gradually became paler, but from its zenith two curved streaks of light were projected upwards, forming what appeared to be the commencement of a second circular halo above the first and arising from it. The diameter of this second halo was apparently much less than that of the first, but it never became sufficiently developed to measure, even approximately. At this time, 2 p.m., the two haloes were like the symbol for the zodiacal sign Taurus (♉). At the point where these two haloes touched one another a luminous area was now formed—the mock sun. It was 2° or 3° across, rounded, but not distinctly a disc like the sun itself. The haloes had by this time faded very considerably, but were still visible when looked for. The parhelion was plain enough, although it resembled a thin place in a cloud obscuring the sun rather than the sun itself. It certainly would have escaped observation had not the whole train of phenomena been watched. The parhelion was watched by ourselves, and Mr. Henry Hoft at his house at Shouldham Thorpe, for some fifteen to twenty minutes. In half an hour it was all but gone, but then came the final phase. From the sun, upwards and downwards, two beams of light extended vertically. These were widest where they started from the sun,

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but gradually were reduced to a point. The upper one almost reached the parhelion, the inferior was lost on the horizon. This last phase was not of long duration, as the sun was clouded over shortly after three o'clock.

I have not been able to find that any one else in Norfolk noticed this parhelion; and, as has been stated above, unless they had chanced to see the halo at its brightest (about 2 o'clock), and watched the various stages through which it passed, it is very unlikely that the true meaning of the bright area in the clouds could have been realised. It is very satisfactory, however, to find that an observer at Fleet in Hampshire also witnessed it, and sent the subjoined account to the 'Times,' 25th December.

A SOLAR PHENOMENON.—"C. J. L." writes from Fleet, Hants, under date December 22nd :—"A strange and, I think, most rare and unusual solar phenomenon has taken place here this morning. The sun was at first surrounded with a well-defined halo, which gradually assumed a heavier and darker form, ultimately presenting a vast and dense ring, the radius of which from the sun to the outer edge of the ring being about 20°. At the zenith of the ring was a rudimentary mock sun, not so brilliant as its primary, but sufficiently bright as to dazzle the eye. Subtended upon the circle was a small segment of a second ring, which appeared to start from the somewhat vaguely formed parhelion. About 20° from a corona of light surrounding the periphery, which appeared to emanate from the nether side of the dark ring, was a beautiful rainbow encircling the whole, exhibiting all the prismatic colours. The nadir of the rainbow (or, rather, fog-bow), and also of the dark circle was concealed behind a low bank of cloud. Viewed from the summit of one of the high hills in this neighbourhood, the spectacle was striking and impressive in the extreme. After a short time gathering clouds concealed the pageant from view, but an occasional break revealed the dark ring as still in existence, though the rainbow was not apparent."

C. J. L. does not mention the vertical line, but he speaks of the parhelion as being sufficiently bright to dazzle the eye, and of prismatic colours in the halo which we did not see in Norfolk.

Mr. W. N. Shaw, of the Meteorological Office, kindly informed me that a solar halo was noted in London at 8 a.m. on the same day. It is probable, therefore, that this halo lasted all day, and

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was visible more or less distinctly according to the degree by which the sun's brightness was obscured by the mist. It is worth bearing this in mind, for whenever the air is full of ice particles a solar halo may appear, and when one is visible it should be watched, from time to time, for parhelia. The only person with whom I have conversed that has actually seen a parhelion, is Mr. Thomas Pung of King's Lynn, who tells me that many years ago he happened to look out of his bedroom window one morning, just after sunrise, when he saw two parhelia, very distinctly visible in the east, the nature of which he at once recognised from the figures given in various books on Arctic travel.

IX.

NATURAL HISTORY NOTES FROM YARMOUTH.

By A. Patterson.

Read 26th February, 1901.

1900—1901.

My notes in last year's 'Transactions' (*vide* page 71) concluded on March 22nd, which date was also made conspicuous in my memory because of being overtaken in a most furious squall on Breydon, in which I actually drave homewards "under a bare pole."

On March 28th, 1900, I saw several Dunlins in their grey winter plumage, not a sign of change being apparent.

The N.E. gales of March-end were fatal to many Rock birds. On the 2nd and 3rd April, between Yarmouth and Winterton, several Puffins and Little Auks were found stranded. The numbers noted were: 30 Little Auks, 2 Razor Bills, 1 Great Northern Diver, 2 Guillemots, 20 Puffins.

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On March 29th several bunches of Starlings in wedge form, flew across, seawards, making due E.

On April 5th, at high-water on Breydon, I witnessed an interesting sight: three grand Herons stood asleep, thigh deep, at the entrance of "Ship Drain." The higher flats were dotted everywhere with Dunlins and Ringed Plovers. Saw a flock of "red" Knots, and three Curlew-Sandpipers also in the "red." A mixed flock of Curlews and Gulls were standing in a shallow, napping. A large Swan was preening itself on the edge of Duffell's Drain, and a Peregrine Falcon made a stoop at some Wild-ducks, but made no capture, being distracted by a flock of noisy Gulls. I also saw a Hooded Crow.

On April 10th I was delighted to find a fish, new to my Yarmouth list, on the South Beach; it was a 4½-inch Planer's Lamprey (*Petromyzon branchialis*), lying conspicuously exposed on a heap of seaweeds. A large Lumpsucker (*Cyclopterus lumpus*) was taken in a shrimp-net, same date.

April 18th. A flock of 100 Widgeon on Breydon, and six unusually light-coloured Geese passed overhead on Breydon on April 19th.

On April 20th, at low water, I twice sailed through a large flock of Widgeon in the Ship Drain; they were unusually tame and loth to budge. It was a beautiful sight, many were perfectly plumaged males.

On April 22nd a rather faded chocolate-tinted Ballen Wrasse (*Labrus maculatus*) was brought me by a smacksman. It was 14 inches long. Is now in Yarmouth Museum, but cannot be claimed as a local specimen.

On April 28th a Spoonbill reported on Breydon.

The connection between the movements of the Grey Plover and a change of weather, generally for the worse, and a S.E. wind, is always to me a matter of exceptional interest. A shift of wind to that quarter usually affords a "show" on the mud-flats, other Waders often arriving at the same time.

A S.E. wind at the period of either Spring or Autumn migration is always hailed by local sportsmen.

May 5th. Caught a Double Flounder on Breydon. The "top" eye rested in the usual notch in front of the dorsal fin, which latter, and the anal fin, were both spotted with red. Both sides of the

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fish were dull brown. That this fish did not swim edgeways up, as double *Pleuronectidæ* are supposed to do, is pretty certain, for my pick tine went quite through the middle of him.

On the evening of May 9th saw six Knots on Breydon. This species is not so common here now as in Autumn.

On May 10th a bunch of thirty tired Grey Plovers alighted on a mud-flat, and forthwith fell fast asleep, so heavily indeed that, as the tide rose, I pushed my punt to within a few feet of them. Some were grandly black-breasted; I sighed for a camera. As the water floated them they awoke and left my company. Several other Grey Plovers were feeding about on other flats. I also saw some Wimbrel, a few Godwits, and some small Waders round about. Wind E.S.E.

My latest record of Hooded Crows is May 11th. Early on that morning I observed five on the Ship Drain flat.

"Joey," my tame Cormorant, was very restless in May, constantly going round his domain in circles, flying from stone to stone, and on to his tree stump. The passing over of a Cormorant on the 10th unusually agitated him, and for some days he amused himself carrying small faggots and such like about in his mandibles, as if anxious to start housekeeping. I have since parted with him.

On the 15th it was cold as winter; wind N.E. Many Wimbrel were scattered over the flats. On the 16th I observed them feeding in couples. I missed the Swifts, which arrived on the 11th for four or five days, during which time the weather was cold.

Two Shovellers, on May 16th, were feeding among the "grass" on the flats, probably collecting some species of Mollusc which abounds here. I am somewhat of opinion that it is seeking for this same Mollusc, tame Pigeons from the town are so frequently seen in the summer months wandering about on the mud-flats. More Shovellers on May 26th.

May 28th. First spring Turnstone seen. June came in wet, cold, miserable. On the 4th, twelve Spoonbills were reported to have dropped down near the Five-stake Drain. They are stated to have stayed there from about 1 p.m. to 2 p.m. Wind N.E.

June 7th. Saw a fine Spoonbill with crest like a mop, near the Ship Drain, in company with Black-headed Gulls. It was remarkably wary and restless, flying off on my nearer approach, the Gulls

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rejoining it. Becoming again suspicious, it flew across the flats and alighted near my house-boat; settling to feed in security.

This, or another, settled in the same locality on the 9th, early in the morning. At eventide I saw two in the same spot. Six Cormorants on Breydon same date.

June 11th. A beautiful green-coloured variety of the Ballan Wrasse (*Labrus maculatus*) was brought from Winterton in a bucket of sea-water, and sold alive on the Wharf. When I called round at a local fishmonger's a few hours after, it had thrown itself out of the pail and died on the bricks. It has since been placed in Norwich Museum.

June 14th. A Spoonbill on Breydon.

July 9th. A perfect albino Sole, over a foot long, on a fish stall.

During the finer days of summer and occasionally in winter, the larger Gulls on Breydon mud-flats, after a satisfactory meal, indulge in a most remarkable performance. Throwing open and upwards their big yellow bills they give vent to a mewing kind of noise which has most weird effects. The birds stand in easy attitudes and continue their "song" for some minutes at a time. There is no noise in nature to which I can compare this strange whining wail. I have dates of "performances" on March 12th and July 11th.

Early in July Redshanks were fairly numerous on the mud-flats.

On the 29th July I saw a solitary Sandpiper actively feeding in a corner of the rond a few paces from my house-boat. I have little hesitation in describing it as a Pectoral Sandpiper. Two Green Sandpipers same date.

August 3rd. Wimbrel plentiful. Heavy S.W. wind. Saw one Tern on Breydon.

On the 4th I spent the night on Breydon, and saw at sunset, from my boat-house, on a flat hard by, 200 to 300 Terns of various species, including Black and Lesser Terns. They were as merry as Crickets.

August 4th. Sixteen Shovellers on Breydon, four were shot; of these I saw three in the market on the 7th.

On August 6th, upwards of 100 Terns were on Breydon (mostly immature, common) with a few longer-tailed Arctics amongst them. A flock of 30 Curlews (same night). Large flock of Ringed Plovers dropped in. Wind N.W. And during a heavy downfall of rain two strange Black Ducks, probably Scoters, settled some way off.

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August 7th. A dozen Lesser Terns (the most delightful of the sea-fliers) on the *Potamogeton* early this morning in the drizzly rain. Wind N. Saw a flock of fifty Curlews in the evening; and the twelve Lesser Terns in company with a few Common Terns on a mud-flat a few feet away from me. They remained all night shrieking around my house-boat. On the evening of the 9th I passed a "dense mass" of them, probably several hundreds. On the 10th they were all gone, a few only turning up at eventide, when some hundreds of Gulls, mostly Blackheads, joined them. The noise they and the Redshanks, Curlews, Wimbrel and others made can simply be described as "prodigious," although most charming to me.

While sailing past the "half-mile point," a hundred yards past the Breydon Bridge Works, I observed a small animal plunge into the water from the walls and swim boldly across channel towards the Five-stake Drain flats. On nearing it in midstream, the animal—which proved to be a Weasel—showed fight, and endeavoured to board the punt, a proceeding I objected to, and was obliged to gently tap him on the head with the blade of the oar. He sank a yard, but on rising to the surface wisely turned again to the shore, and finally disappeared in the stone embankment. I had no desire to hurt him, but a desperate Weasel in a boat was undesirable. Some Gulls on the flat had evidently tempted him to make the experiment.

Was much interested on the morning of August 21st watching some small Waders on a mud-flat. An immature Turnstone was eagerly turning over bits of wood and mud in pursuit of Sandhoppers. Some Dunlins and Ringed Plovers persistently gathered in the escaping prey before he could reap the reward of his exertions, until, becoming desperate, he repeatedly drove them away, and finally went away himself to seek a quieter hunting-ground.

August 22nd. A Spotted Redshank on Breydon and several Curlew-Sandpipers.

While Smelting with Jary the watcher, I caught a number of Atherines (*Atherina presbyter*).

On August 25th, several sacks of Norwegian Lobsters (*Nephrops norvegicus*), from the North Sea, brought to the Wharf.

September 2nd. Black-tailed Godwit shot, two others seen; and several Greenshanks during first week in September.

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I purchased from Durrant a Great Snipe on September 8th. It was unusually dark in colour, and more than usually light in weight.

On September 5th, a Short Sunfish (*Orthagoriscus mola*), measuring two feet in length, was caught in the roadstead and brought to the Fish Wharf. Several Landrails in the market during first fortnight in September; eight were on sale on the 12th at one time.

The Caterpillars of the Privet Hawk Moth appear to be commoner yearly. Privet is more largely grown in this neighbourhood each year.

On September 17th I had in my possession two small claws of the Edible Crab (*Cancer pagurus*). One had the end section double-pointed, but these did not work separately: the other, which was also double-pointed, had a free movement in both.

October 12th. Larks and Rooks coming over freely to-day.

October 13th. A 22-lb. Salmon, in excellent condition, caught in a herring-net.

October 15th. A Lumpsucker (*Cyclopterus lumpus*) caught on a hook in the river near Fish Wharf. First flight of Woodcocks noted same date.

On October 26th a hungry Great Grey Shrike, evidently but just "over," alighted in a tree in St. George's Park. Presently it flew at and struck a Sparrow with which it returned to its perch; the shrieking of the unfortunate finch attracting quite an assemblage of onlookers, before whose eyes it tore its victim to pieces and made a meal of it, flying away unmolested a few minutes after.

Two Porbeagle Sharks (*Lamna cornubica*) caught first week in November. One was about 6 feet long; the other, 7 feet 6 inches. Both made themselves disagreeably unwelcome by enveloping themselves in the drift-nets.

On November 3rd I saw a Common Snipe on the muds of Breydon, a most unusual place to flush one.

November 21st. A Woodcock, captured in a warehouse in the town, came into my possession. It became quite tame in a day or two and would take worms out of my hand, pecking at my fingers petulantly if offered without food, and at the same time uttering a not unpleasant purring note. It lived several days in my possession, during which time it partook eagerly of *Oniscidæ*, strips of fish, liver, and meat. But it gradually pined and died. I have always understood that the cock was difficult to keep in confinement, and took great pains to prove this a falsity. I have kept a great

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variety of species in my time, but never an easier—*save for satisfying its hunger*, and here I failed; and I am satisfied that it is next to impossible to succeed in doing so, for it would require one man's time devoted entirely to digging or collecting worms for its sustenance.

Nov. 26th. Several Little Auks shot off the beach. Nine Egyptian Geese on Breydon. Five shot by one punt gunner, and two others obtained by shoulder guns. Some were fine, unpinioned birds. Their very tameness would warrant them "escapes."

On December 3rd a fine ♀ example of the LESSER RORQUAL WHALE (*Balænoptera rostrata*) was cast ashore, dead, on Caister beach. It was by no means fresh, but bore no marks of violence other than those which might have been caused by tumbling about on the sands. Length 30 feet; tail flukes, 7½ feet from point to point; pectoral fins, 4 feet long. After interesting or disgusting many visitors, the coast-guard employed labour to hack it to pieces and bury it in the sands.

On December 5th a Herring 15½ inches long shown me, and three other large Norwegians on December 11th. One measuring 15 inches long, was 7½ inches in girth, and weighed 14½ ounces.

Several large flocks of Golden Plovers passing over at Potter Heigham on December 6th. I saw two examples turn Durrant's scale at 9½ ounces each on the 15th.

Very few Wild-fowl of any kind brought to market up to the end of 1900.

1901.

Open weather here until January 8th when sharp weather and snow set in, with them arriving several Swans: two Bewicks being shot.

On January 12th two Goosanders in market, and a grandly attired ♂ Gadwall, one wing convincingly proclaiming it an escape.

February 12th. Two White-fronted Geese shot.

A streaked Gurnard (*Trigla lineata*), twelve inches long, brought me on February 18th.

February 23rd. Pied variety of Thrush, shot at Tunstall, in the market. The secondary and primary feathers were mostly white.

Latter part of February saw several Puffins and Little Auks washed up on the beach.

The call of the Redshank heard on February 27th.

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On March 2nd a ♀ Wigeon on Durrant's stall, assuming the male markings.

March 5th. From a Whiting, 9½ inches long, I drew an example of the same species 7¾ inches long, about an inch and a quarter only remained out of the swallower's mouth.

Up to March 14th I have received several examples of *Mus rattus*, and the much rarer sub-species, *Mus alexandrinus*. These Rats have become increasingly troublesome to grocers, swarming overhead and below-stairs, and nothing savoury is free from their attacks. I was recently shown, on two occasions, rows of empty jam jars, clean licked out, as if they had been legitimately emptied and washed. I also, in one shop, saw a half-hundredweight box of dates eaten out until but a mere shell-like cavern remained. In the sail-lofts the Russian tallow used has to be carefully hidden, for any lumps left about are sure to be devoured before morning.

On Thursday, 21st, an enormous Conger (*Conger vulgaris*) was brought in by a trawler. Length 7 feet 6 inches, weight 92 lbs.

After a week's heavy easterly winds I went to Ormesby, walking home by the beach. The sandcliffs had been woefully scoured, and crumbled down by thousands of tons. This continual abrasion promises to be a serious matter before many years have elapsed. No efforts to stay the force of the sea, either by groining or otherwise, are being made, and the sand drawn down by the sea being levelled and washed away affords no protection to the abrupt cliff, at whose base every unusual tide now flings its breakers.

At Scratby, more particularly to the northward, this devastation is most conspicuous. At the base of the cliffs, in places, a great deal of drift had been thrown, and amongst it some number of unfortunate Rock-birds. I found several Guillemots, Puffins, and Little Auks; only two or three of the former being in a state fit to bring away; their rather rapid decomposition, and the onslaught of Rooks and Crows having spoiled them.

I found about eight dead Rooks and several Starlings, probably northward bound emigrants, that had succumbed to the fury of the elements. A few Kittiwake remnants lay about, and the wings and breastbones of several Larks and smaller birds. Thousands of a species of *Hyperia* in places were strewn along the tide-mark.

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DELPHINUS DELPHIS, SHOWING PARALLEL SKIN-SCRATCHES.

From a Photograph by Mr. E. Wilson of Cambridge.

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X.

ON SOME MARKINGS ON THE SKIN OF A DOLPHIN (*DELPHINUS DELPHIS*).

With Plate.

By Sidney F. Harmer, Sc.D., F.R.S.

Read 26th February, 1901.

The specimen referred to in this note was captured in a Pilchard-net, three miles off Mevagissey, Cornwall, early in September, 1900. It was sent to the University Museum of Zoology, Cambridge, through the kind offices of Mr. Matthias Dunn of Mevagissey. The total length was 6½ feet, measured in a straight line. The stomach contained the remains of about twelve nearly digested Herrings, and the reproductive organs were those of the female sex.

Mr. Dunn's reason for sending me this specimen was the existence of numerous remarkable series of equi-distant, parallel scratches, some of which are clearly brought out in the figure. The scratches were usually longest in the middle of the series; and most of them came within the limits 8—60 mm., although this length was considerably exceeded in some cases. They were for the most part 5 mm. apart, the greatest distance noted between two scratches of one series being 7 mm. The maximum number found in any one group was 22, but some of the groups consisted of only a few scratches. They occurred quite irregularly over the body. On the left side they were most numerous on the thickest part of the body, but they were found on both sides, on the body, on the root of the tail, on the two surfaces of the pectoral fin, and in other positions. There could be no doubt that they were wounds, since they occurred in all conditions, from deep scratches which were clearly of recent date to completely healed ones still visible as slight scars. This shows that the markings cannot have been caused during the capture of the animal. The triangular series seen in the figure just behind the eye, and described below, consisted of recent scratches. In the one immediately below its widest portion the skin had recently healed.

This specimen excited my interest largely in consequence of

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certain statements by MM. J. Richard and H. Neuville,* on the skin-markings of *Grampus griseus* and *Delphinus delphis*.

These authors support a view which they attribute to Captain Chaves that the striae and circular marks usually found on the skin of *Grampus griseus* are the results of wounds inflicted by Cephalopods.

M. Chaves is said to have photographed a specimen showing the impression on the skin of the series of suckers of a tentacular arm of an *Architeuthis*, besides "de nombreuses lignes parallèles produites probablement par le frottement des cercles cornés de ces ventouses." He has further pointed out an exact correspondence between certain circular marks on a fragment of the skin of the same species, and the dimensions and denticulations of the suckers of *Architeuthis*.

I was at first inclined to ascribe the markings shown in the figure to a similar cause, and it appeared to me that the hooks on the ends of the tentacular arms of *Onychoteuthis* might have produced this effect. Although this genus does not occur in our own waters, this fact is not a sufficient proof that the scratches were not due to this cause, since it is quite possible that this particular Dolphin may have come from a great distance. On further consideration, however, it appeared improbable that the scratches were produced by a Cephalopod. Although the distances between successive scratches of one series corresponded well enough with that between the hooks of an *Onychoteuthis*, the assumption that they were due to this animal would necessitate the conclusion that the tentacle moved sideways along the skin in producing them. It is difficult to see how this movement could be produced with sufficient force. If an *Onychoteuthis* were to commence to scratch a Cetacean, the marks due to the several hooks might at first remain separate on the skin, the length of the entire series corresponding with the length of the tentacular "club;" but the arm could probably only pull in the direction of its length, and the series of scratches would soon overlap and fuse into a wound corresponding with the *breadth* of the tentacular arm. This in fact is very much what appears to have happened in the series of scratches seen in the figure just behind the eye; but the evidence derived from this series is discounted by the fact that the other series show no tendency to this arrangement.

* "Sur quelques Cétacés observés pendant les Campagnes du Yacht Princesse-Alice," Mém. Soc. Zool. France, 1897, pp. 102, 108.

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Mr. M. Dunn, to whom I mentioned the possibility that the scratches were due to Cephalopods, from the first discredited the idea; and I have come round to the view which he suggested to me that they were produced by other Dolphins, by movements not unlike those by which a Pig uses its tusks. Mr. Dunn further remarks that the wounds may have been inflicted by males during their efforts to effect sexual intercourse; and Mr. T. Southwell has expressed much the same opinion in a letter to me.

A slight lateral movement of the lower jaw of a Dolphin would probably suffice to make the teeth project enough to inflict wounds on the skin of another animal. Measurements made on two dried skulls show that the points of the teeth are about 5 mm. apart, which is precisely the usual distance of the scratches from one another.

The most remarkable series is the one shown in the figure, on the right side of the body, just behind the eye. This consisted of twenty-two scratches, beginning on the back just behind the blow-hole. In this position the series was 95 mm. wide. As it passes ventrally it diminishes rapidly in width, ending just behind the eye with a width of only 10 mm., the scratches being of course no longer individually distinct. On measuring the distance from tip to tip of the first twenty-two teeth of the lower jaw, and of twenty-two teeth further back in the upper jaw, in the region where the teeth project most in a lateral direction, of two dry skulls of *D. delphis* in the Cambridge Museum, I get the following results for the two sides:—

	Lower jaw.	Upper jaw.
No. C. 124. B.:	—102,105 mm.	108,103 mm.
No. C. 122. B.:	—100,96 mm.	103,98 mm.

These measurements correspond very closely with the total width of the series of twenty-two scratches at its widest part. To explain its diminution in width it is only necessary to suppose that at first the two Dolphins were swimming side by side, but that at the end of the process leading to this particular series they were pulling apart in opposite directions.

Although accepting Mr. Dunn's view of the nature of these markings as the most probable, I do not think that this gives any reason to doubt the accuracy of previous statements to the effect that skin-markings in certain Cetacea may, in some cases, be due to wounds inflicted by Cuttle-fishes during the process of being captured and devoured.

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XI.

THE MOSQUITO-MALARIA THEORY.

By Sydney H. Long, M.B.

Read 26th February, 1901.

The subject of my communication this evening, viz., the relationship between the Mosquito and the disease known as Malaria, is one which at first sight might appear to be of too technical a nature to be discussed by the members of this Society; yet it is really one upon which many of our members can probably add some new facts to those that have so rapidly been brought to light by investigation in this country and elsewhere during the last year or so. For this reason I have thought it fitting to attempt to lay before you in review a brief résumé of the work in this connection that has already been accomplished, and with which some of you are probably in part familiar.

Two or three hundred years ago the causes of many diseases were represented as Spirits, Witchcraft, the Evil Eye, &c., only to be met by such means as the King's Touch, Spells, and Incantations; and even at the present day, in some of the outlying parts of this county, we find that traditional superstitions of this nature still have their advocates amongst some of the less enlightened of the rural population. Happily, however, for human nature, the Nineteenth Century produced men who would not rest content with doctrines based upon such slender foundations as those they inherited, and with the increasing means of research that have gradually been evolved out of the microscope and in other ways, the study of medicine may now justly be called a true science.

One of the greatest, and most far-reaching in its beneficial effects, of the discoveries of the Nineteenth Century is, in my opinion,

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that which is the subject of my present paper. It has of late not only been engaging the closest attention of members of my own profession, but it has also excited considerable interest in the minds of the general public. And rightly so; for when we consider the far reaching, and it would seem ever-increasing, extent of the British Empire, and the fact that her sons may be called upon at any time to uphold its dignity and freedom of action in any part of the world, it is only right that they should possess a full knowledge of all available means of avoiding one of those diseases which is so universally present within certain latitudes, and which is the cause of so many shattered constitutions amongst our soldiers in after life.

In the elucidation of this Mosquito-Malaria Theory, which, by the way, was first promulgated by one of our own epidemiologists, Dr. Patrick Manson, I am proud to say that Englishmen may be accredited with their full share of the discovery, which has only been arrived at by a most careful and scientific investigation.

Now Malaria or Ague, for the two words are synonymous, is a disease of varying type, but it may roughly be said to be characterised by regularly or irregularly intermittent fever. There are usually three stages: the cold shivering stage, when the temperature of the body is rising; the hot stage, when the temperature has reached its height; and the sweating stage, when the temperature is falling again. These three stages constitute an "attack," and as to whether these "attacks" occur every day, or every other day, or with two days interval, the Ague is said to be quotidian, tertian, or quartan in type. Such attacks may recur, unless checked by the internal administration of some drug, with more or less regularity for an indefinite period; but what is perhaps most aggravating about the disease is the fact that the sufferer may have been free from "fever" for a long period of time—months or even years—and yet after this interval he may get another attack for no apparent reason. Such is the common experience of Anglo-Indians who return to reside in this country.

Malaria has been recognised as a definite disease since the time of Hippocrates; and, moreover, the older observers were fully alive to the fact that it was most prevalent within certain latitudes. They further associated the disease with unhealthy and swampy places, where the air was continually being poisoned with the miasma arising from the soil. The disease was known to be infectious, and

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in certain countries new-comers were almost certain to contract it. Not until the introduction of Peruvian Bark into Europe, in the seventeenth century, was any drug known which exercised a controlling influence upon the disease. In the year 1880 a Frenchman named Laveran discovered with the aid of the microscope adventitious living organisms in the blood of those suffering from ague, and he rightly concluded that herein lay the cause of the disease. A good deal of scepticism was shown at first with regard to the identity of this parasite; but thanks to the indefatigable labours of Dr. Manson and others, its causal relationship cannot now be denied by any one who is familiar with its life-history.

It is necessary for me to say here that the parasite in question belongs to the Protozoa Class—Order Sporozoa. The characteristics of this order are that they consist of proper cellular elements, made up of protoplasm, a nucleus, and nucleolus. They possess Amœboid movement, and are true Endo-cellular parasites, living at the expense of the cells they have invaded. They multiply by the formation of spores, hence their name. The Sporozoa are further divided into various Sub-orders, and it is to one of these—the Sub-order Haemosporidia—that the Ague parasite belongs. The main features of this Sub-order are an alternating generation with two evolutionary cycles; the one endogenous and asporular, which determines the reproduction in the tissues; the other exogenous and sporular, which permits contagion and ensures the conservation of the species.

In the life-history of this Ague parasite, man forms the temporary host, and in his blood the asexual cycle is performed; whereas the cycle of sexual life is completed in the Mosquito, which may therefore be called the definitive host. In the Mosquito the parasite reaches the salivary glands, and here they accumulate in large numbers. The Mosquito, biting man, inoculates him with its saliva, plus a certain number of the parasites, which, developing in the blood of man, produce those asexual parasitic generations which I have demonstrated to you under the microscope and by my diagrams. We thus see that in man the parasite lives in, and at the expense of, the red corpuscles of his blood upon which it feeds, and that concurrently with the different stages of an Ague attack it passes through a cycle of changes. It is now known, moreover,

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that a different parasite is associated with the different kinds of Ague—tertian, quartan,* &c., so that by examining the blood of a suspected case and finding the parasite, the kind of Ague from which it has been taken can be identified. This can be done by merely taking a drop of blood from the finger and examining it under a high power of the microscope. This cycle of change in the blood of man had been accurately noted by several independent observers; but the question to be settled was, how did it gain entry into the blood, and what was the animal or insect in which the other part of its life-history, *i.e.*, the sexual cycle of its existence, was passed?

In 1894, Manson originated the idea that the malarial parasite was capable of an existence outside the human body, in which the "flagellate" form played an important *rôle;* and he was led to suggest that the Mosquito served as the definitive host for the further development of the parasite, as it was known to do for the *Filaria nocturna*, which is the cause of certain other tropical diseases, and which has I believe on a previous occasion been demonstrated to this Society.

At the instigation of Dr. Manson, Surgeon-Major Ross of the Indian Medical Service went out to India to make experiments and investigations on this point. A laboratory in Calcutta was set apart for his use, and in February, 1898, Ross commenced his investigations. There being few cases of human Malaria at this season of the year, Ross turned his attention to certain birds, such as Sparrows, containing in their blood the form of bird parasite known as *Proteosoma grassii.* He made a certain kind of Mosquito (*Culex pipiens*) bite infected birds, and by successively dissecting each day a Mosquito of those which had bitten the birds he discovered the life cycle of the Haemosporidia in this insect. He discovered that the pigmented bodies grew rapidly within the Mosquito till in about a week they projected like buttons from the outer surface of the stomach. Having reached maturity they burst into the general body cavity, setting free enormous numbers of so-called "germinal rods." These latter were found soon to leave the body cavity and to accumulate in the cells of the salivary or poison glands, and in the duct leading from them to the proboscis,

* The differentiation between the tertian and quartan forms of fever was first demonstrated by Golgi, of Pavia, in 1889.

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with which the insect inflicts its bites. He further completed the biological cycle of evidence by demonstrating that healthy Sparrows could be infected with the Proteosoma by the bites of hand-reared Mosquitoes previously fed on infected birds. These researches have since been confirmed, both in general bearing and in detail, by the observation of the fertilisation process in the case of halteridium of birds (*Haemamoeba danilewskii*), as well as of human aestivo-autumnal parasites (*Haemomenas praecox*).

I might here remark, by the way, that besides man, certain Batrachia and Reptiles are known to suffer from Malaria, and the endoglobular form of the parasite in the edible Frog (*Rana esculenta*) has been worked out, though what the definitive host is in this case it is not yet known. Many birds similarly suffer from the disease, and in the case of the Pigeon (*Columba livia*), the Lark (*Alauda arvensis*), and the Little Owl (*Athene noctua*), the parasite has been identified. In mammals, Malaria is known in Oxen, Calves, Sheep, Lambs, Dogs, and probably in Horses also. Bovine Malaria has long been noticed in certain districts where human Malaria exists, and that it attacks preferably imported breeds. Smith and Kilborne have demonstrated that the parasite is transmitted to Oxen by the bite of a special tick, the *Ripicephalus annulatus*, about the size of a pin's head. After sucking the Ox's blood the tick falls off engorged and subsequently lays an egg, and the daughter ticks are capable of again transmitting the disease. These ticks are constantly found in districts where bovine malaria prevails.

Having said this much, most of you will, I expect, be convinced of the truth of this Mosquito-Malaria Theory, but in case any should still remain unbelieving, I will quote two experiments which in themselves should be convincing.

Speaking last year of how to impress upon the English public the importance of the Mosquito-Malaria Theory, Dr. Manson said: "As the histological, biological, and experimental evidence which had satisfied men of science was not understood by the public, it seemed to me that some simple demonstration was required such as would be unanswerable, and at the same time readily comprehended by laymen." Two Italian investigators, Grassi and Bignami, had already proved Malaria to be conveyed by the Mosquito, but their experiments, although undertaken with every possible precaution,

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were conducted in Rome, the hot-bed of Malaria; and being in a foreign country would not impress the sceptical in this country in the same way as if such a demonstration had been undertaken in our midst. "It occurred to me, therefore," Dr. Manson goes on to say, "that if I repeated Grassi and Bignami's experiments in a more dramatic and crucial manner, that if I fed laboratory-reared Mosquitoes on a malarial patient in a distant country and subsequently carried the Mosquitoes to the centre of London, and there set them to bite some healthy individual free from any suspicion of being malarial, and if this individual within a short period of being bitten developed malarial fever, and showed in his blood the characteristic parasite, the conclusion that Malaria is conveyed by the Mosquito would be evident to every understanding, and could not possibly be evaded." An experiment of this nature was made last year, and the subject of it was Dr. Manson's son, a medical student of Guy's Hospital. Mosquitoes were fed in Rome upon a subject of Malaria of the benign tertian type; the purity of the infection having been previously determined by many repeated examinations of the patient's blood. These Mosquitoes were then despatched to London in a specially constructed cage covered with Mosquito netting on a wire frame. In forty-eight hours they arrived in London, some having died on the journey, though several still survived. Mr. Manson allowed the Mosquitoes to infect him by placing his hand in the cage and letting the Mosquitoes bite it. As, however, the first consignment of Mosquitoes were languid after their journey they did not bite well, and so a second and a third lot were sent; twenty-five of these latter bit Mr. Manson on one day and ten on the next. In due course Mr. Manson developed typical tertian Ague, and the parasites known to cause this type of the disease were found in his blood by several skilled and independent medical men. After a period of about four days, quinine was administered to him, and the shivering fits ceased, and within a few hours the parasites had disappeared from his blood.

The other experimental proof that I will quote to you is the following:—During this last summer (1900) two medical men, Drs. Sambon and Lowe from the London School of Tropical Medicine, being convinced of the truth of the Mosquito-Malaria Theory, volunteered to go out to Italy and live on the Roman Campagna for four months (June—October) during the height of the malarial

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season, merely depending upon Mosquito protection as a preventative against the disease. The place chosen by them was near Ostia, on the mouth of the Tiber, "a water-logged, jungly spot teeming with insect life." This part of the Campagna is so infested with the disease that all the labourers who go to reside there during the harvesting operations invariably contract it, and hardly any one passes a night there during the malarial season who does not fall a victim to the effects of the poison. These two men took with them a wooden hut, constructed in England, and in this they dwelt. The doors and windows of the hut, and every other possible source of entry for Mosquitoes were carefully guarded with wire Mosquito curtains. They did not take a grain of quinine with them. During their stay there they were always careful to be in their hut one hour before sunset, and not to leave it again until one hour after sunrise; the rest of the day they spent outside, ever having an eye for Anopheles. Both these men have since returned to England, and neither has developed Malaria, as they assuredly would have done long before now had they been infected.

Having proved to you, as I hope, that there is now no longer a shadow of a doubt but that the Mosquito acts as a carrier of the Malaria infection, we will now briefly review what is known of the *Structure*, *Life-History*, and *Habits* of these very interesting little insects.

I must tell you first of all that only Mosquitoes of a certain genus, the Anopheles, have so far been shown to serve as hosts of the malarial parasite, and of the forty-two species of the Anopheles at present identified, eight (and possibly more) are capable of doing this. There are three species known in England: *Anopheles maculipennis* (vel. *A. claviger*), *Anopheles bifurcatus*, and *Anopheles nigripes*. Of these three, the *Anopheles maculipennis* is by far the most common, and is the most widespread over the continent of Europe. The species with which these are most likely to be confounded are the Culicidae, and as it is a rule that only the female sucks blood, it is important to be able to differentiate the female Culex from the female Anopheles, for the evidence of a considerable amount of experimental work entirely exculpates Mosquitoes of the genus Culex from any part in the transmission of human malarial fever. The two diagrams I now show you will serve to make this difference evident.

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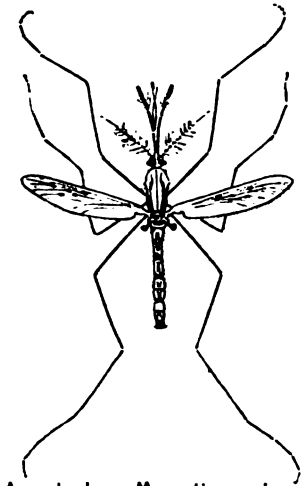
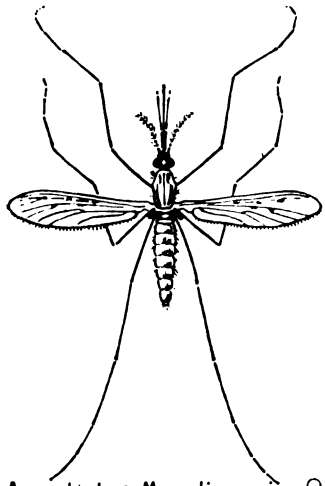


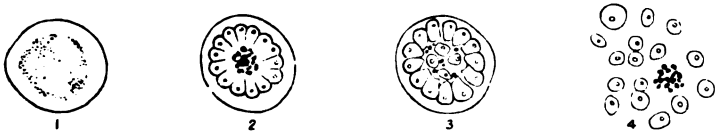
Anopheles Maculipennis ♂



Anopheles Maculipennis ♀

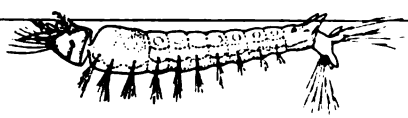
Head of Female Anopheles

Head of Female Culex

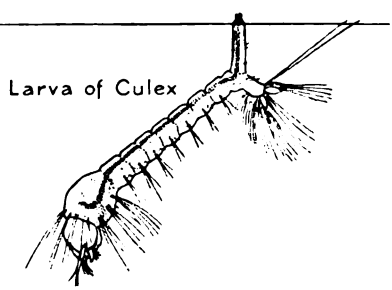


Blood Corpuscles

Containing Malaria Parasites



Larva of Anopheles



Larva of Culex

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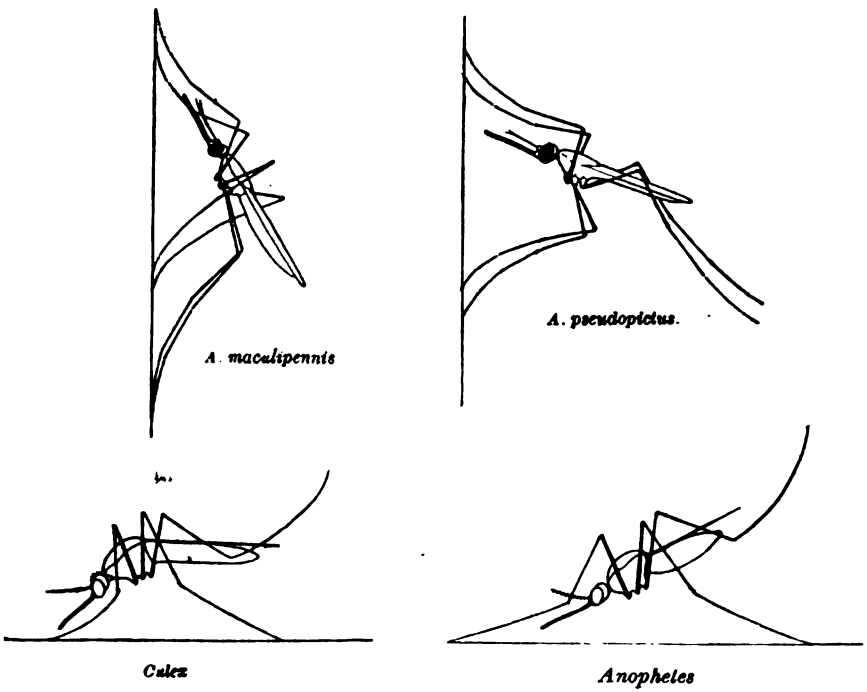
In Anopheles, the palpi, in both male and female, are as long as the proboscis; in Culex, the palpi in the female are much shorter than the proboscis. There are several other minor points of difference, but this difference in the length of the palpi is easily seen by the naked eye, and serves as a ready means of differentiation. The *Anopheles maculipennis* has four black spots on each wing



arranged in the shape of a T, the horizontal bar of which is partly wanting. This is also easily recognised by the unaided eye, and can be seen in the mounted specimens of the insect I will hand round to you.

Another means of distinguishing the Anopheles from Culex is by observing the position of the insect in the resting state. In Culex the head and thorax form an angle with the rest of the body, giving the insect somewhat of a hump-backed appearance; whilst when Anopheles is at rest, the head and thorax and the rest of the body are in one straight line. This is seen in the diagrams I show

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you. It was at one time asserted that *A. maculipennis* could be distinguished at a glance by the fact that when resting on a vertical surface, such as a wall or mosquito curtain, it sits with its body forming an angle of about 30 degrees to the surface, whereas with the other varieties of the Anopheles and the Culex this angle between the body and the supporting surface is one of 70 or 80 degrees. I mention this, and show diagrams to represent more exactly my meaning, because it has been stated in many papers that this characteristic can be used as a means of distinguishing this species generally; whereas it has since been pointed out by Dr. Sambon that it holds good only for the species of a certain locality, the West African coast.

With regard to the Life History of the Anopheles, time will not permit of my entering into this. I here show you some beautiful drawings by Drs. Nuttall and Shipley, kindly sent to me by one of the authors, which show the evolutionary changes that take place from the egg through the pupa stage to the imago or perfect insect. The female Anopheles lays about one hundred eggs, and these are deposited upon the surface of water containing suitable material, such as Algæ, as food for the larvæ. On the second or third day the larva leaves the egg. As far as the evidence at present goes, it would appear that the eggs are non-resisting to hibernation, and can only be carried through the winter in the body of the female Mosquito. The larva of Anopheles moves in the water tail first, and it lies with its body parallel with the surface, whilst the body of Culex hangs nearly at right-angles to the surface. By this means the larva of Anopheles can be distinguished from that of Culex. Anopheles larvæ are nearly always found in clear water, whereas that of the Culex does not appear to find sufficient food in water of this kind. The larval period lasts from eighteen to twenty-one days, the length of time depending considerably upon the temperature. The pupa develops into the imago in from two to three days.

With regard to the habits of Anopheles, there are some here this evening who could probably give many facts from their experience of these unwelcome insects so often met with during the summer months on the rivers and broads of this county. *Anopheles maculipennis* seems to be quite the most domesticated of the species. During the day they remain hidden and sheltered in

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shady and damp woods, in trees, huts, dwelling-houses, stables, &c. and it is only at night that they come forth from their hiding-places to bite man. When there is much wind they usually do not venture forth from their hiding-places. They never fly far from the place where they are hatched, and they do not rise to any great distance from the ground. Blood-sucking is an acquired habit of these insects, and there are several others of the Diptera that display the same propensity.

Quite recently, Messrs. Nuttall, Cobbett, and Strangeways-Pigg have made extensive observations upon the distribution of Anopheles in England, and they have produced two maps, one showing the former distribution of Ague and the other the distribution of the Anopheles. From these maps it is seen that there is a very striking similarity between them. From the Ague map you will see that formerly Malaria was known to exist in many places in East Anglia. In Norfolk there is evidence to show that cases have been recorded from Lynn and the neighbourhood, in which district severe Ague was prevalent in 1844. At Wells it was formerly frequent, and at Walsingham there were cases in 1859. It doubtless also was prevalent in many other parts of the county, especially in the marshland and broad districts. In the fens, the so-called Fen-Ague has been known for many years, though it is much less common than formerly. In a recent communication from Dr. Galletty of Northwold, about a case I heard of in that district, he says: "It was the only case of the kind (Fen-Ague) I have seen since I came here seven years ago." There were nineteen cases of Ague treated in the Norfolk and Norwich Hospital from 1820 to 1860. During the five years that I have been connected with this Institution only one case has been admitted, and that from Acle in 1897. You see also that its previous occurrence is reported from many places around the mouth of the Thames and from the Romney marshes. Also in several isolated places in England. In his 'Tour through the Eastern Counties, 1722,' Defoe says, in speaking of the Hundreds of Essex: "I took notice of a strange decay of the sex here; insomuch that all along this country it was frequent to meet with men that had from five or six to fourteen or fifteen wives; nay and some more. . . . The reason, as a merry fellow told me, who said he had had about a dozen and a half of wives (though I found afterwards he fibbed

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a little), was this; that they being bred in the marshes themselves, and seasoned to the place, did pretty well with it; but that they always went up into the hilly country or, to speak their own language, into the uplands for a wife. That when they took the young lasses out of the wholesome and fresh air they were healthy, fresh, and clear, and well; but when they came out of their native air into the marshes, among the fogs and damp, there they presently changed their complexion, got an ague or two, and seldom held it above half a year, at most: and then," said he, "we go to the uplands again and fetch another."

Comparing these two maps, we see that in most places where Ague previously existed the Anopheles is found. It is further seen that the distribution of the Anopheles extends over a considerably wider area than does the distribution of Ague.*

To what factor or factors may we ascribe the disappearance of Ague from those parts of England where it was known to be prevalent years ago. It is certainly not due to the extinction of the Anopheles. Messrs. Nuttall, Cobbett, and Strangeways-Pigg express the opinion that it is probably due to several causes acting together.

(1) A reduction in the number of these insects (the Anopheles) consequent upon drainage of the land, this being in accord with all the older authors who attributed the disappearance of Ague largely to this cause.

(2) Reduction of the population in infected districts as the result of emigration about the time when Ague disappeared from England. This would naturally reduce the number of infected individuals, and thus lessen the chance of the Anopheles becoming infected.

(3) It is possible that the use of Quinine has reduced the chance of infecting the Anopheles through checking the development of the parasites in the blood of subjects affected with Ague. They further go on to say: "The possibility is not yet excluded

* These maps are by no means yet complete, so that if the reader should find any species of Anopheles in the county, and would communicate the fact to the writer, *and send specimen of the Gnats found*, the latter would be greatly obliged, and would render what assistance he could in the identification of the same. Mosquitoes are easily killed in an ordinary collectors' killing bottle, or by tobacco smoke.—S.H.L.

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of there being another intermediary host besides man capable of harbouring the parasite, and, assuming that this were so, this host may have become extinct in the lowlands, where it is known that the fauna and flora have altered."

Preventive Measures.

So prevalent is Malaria in many parts of the world, rendering many thousands of square miles of fertile country practically uninhabitable, at any rate by white races, and causing a yearly mortality of millions of human lives (in India alone it is estimated that it kills every year some five million people), that any suggestions based upon our present knowledge which are likely to diminish in any way the spread of the disease cannot fail to be of inestimable value to mankind. Such methods can be directed towards (1) diminishing the number of the Mosquitoes; (2) protection against the bite of the Mosquito; (3) extermination of the malarial parasite; (4) isolation of the infected. The best way to diminish the number of Mosquitoes is obviously to diminish the number of their breeding-places. This can be effected in some districts by a system of drainage as has been carried out in the Fens and other parts of England. At other times the filling up of pools and small lakes will effect the same object. In many parts of the world, however, so vast are the areas to be drained, and so stupendous would be the work necessary to carry this out, that other means of attaining the same end must be thought of. That which naturally first suggests itself, is a destruction of the larvæ of the insects in the water in which they are hatched. Various methods have already been employed to secure this end, the chief of which are:—

(1) The breeding of fish in ponds, with the idea that the larvæ would fall a prey to the fish as food. This method has been unsuccessful.

(2) The rearing of water Dragon Flies, knowing that these insects are carnivorous and destroy the Mosquitoes and their larvæ. So prolific, however, are the Mosquitoes that this means has failed.

(3) The addition to the water of various soluble mineral salts that are known to be lethal to the larvæ, *e.g.*, corrosive sublimate, potassium bichromate, potassium permanganate, &c. The objection to the use of such substances as these is obvious.

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(4) Certain aniline dyes, the two most potent of which are larvicide and gallol, have been proved to cause the death of the larvæ in from twelve to twenty-four hours in very dilute solution (the minimum larvicidal dose in twenty-four hours of larvicide is 0·00015 per cent.). The great advantages that these possess over other chemical substances are that they are rapidly diffusible in water, and non-poisonous to man and beast.

(5) The pouring of petroleum on the water has been advocated and practised in some places, the oil causing the death of the larvæ by preventing the latter rising to the surface and thus depriving them of their necessary supply of oxygen. This is a method which can be adopted in certain localities, though obviously it does not admit of anything like an universal application.

(6) The powder made from the unexpanded flowers of certain plants, *e.g.*, Chrysanthemum and Pyrethrum cinerariæfolium, have a germicidal action upon the larvæ, and as these plants often thrive in malarious districts, it is conceivable that their cultivation on the large scale might be the means of rendering such districts habitable.

The odour emitted by certain substances, such as garlic, camphor, &c., will cause the death of the Mosquito, as will certain fumes, especially tobacco-smoke. The best time of the year to wage war against both the Mosquito and its larvæ is during the winter and early spring months, for at this season they exist in fewest numbers, and when more exact information is at hand as regards the habits of these insects during the colder months, it is not improbable that a considerable destruction of them might be brought about yearly by fumigation and other means.

Eucalyptus trees have been imported and planted in certain parts of Italy, with the idea that the oil exhaled from their leaves would act as a germicide to the insects, but the experiment did not meet with the success that was expected.*

With regard to the best means of protection against the bites of the Mosquito, there are several precautions that should be adopted by those living in malarious districts. In the first place, the clothing

* Indirectly, I believe, the importation of the Eucalyptus into Italy has been the means of diminishing the number of Mosquitoes; for, being trees that exhale a large amount of moisture from their leaves, they tend to drain the water from the surface soil to their roots, and thus diminish the number of breeding places for Mosquitoes.—S. H. L.

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should be of such a thickness that it is impossible for the insect to bite through it. The parts usually bitten when out-of-doors are the ankles, which are generally covered only by a single thickness of sock. By the use of double socks, Mosquito boots and puttees, the ankles may be completely protected. When possible, it is advisable not to be out in the open air between the hours of sunset and sunrise, for it is between these hours that the insects come out from their hiding-places in the hopes of being able to satisfy their hunger by the blood of man. Sleeping in the open air, unless thoroughly protected by Mosquito curtains, should always be avoided. If it should be necessary to be out at night time the hands should be protected by gloves attached to the sleeves, and the head and face by some form of covering, such as a cowl. All windows and doors of the house should be carefully protected by Mosquito curtains, which are made either of muslin, or, better, of wire. A light should never be allowed in the sleeping compartment when the window is open, and before going to bed a thorough search should be made for any stray insect that may have inadvertently gained entry during the day.

I would here like to add what may not be generally known, that, besides the Mosquito, several other insects probably play no unimportant part in the spread of disease.

As has been pointed out by Nuttall, it appears that the natural tendency to crush a fly that is biting one is especially fraught with danger, owing to its virulent contents being rubbed into the wounded skin; for it would seem that in many cases, where the infection has been attributed to the bite, it is the crushing of the insect that has led to infection. The ordinary House-fly (*Musca domestica*) has been proved to carry about and deposit the bacilli of anthrax in their excreta. It has also been proved to be able to carry the infection of plague, in the dissemination of which disease Ants and Fleas also probably play an important *rôle*. Bugs and Fleas have so far been proved not to occupy any very important part in the spread of disease.

House-flies play an important *rôle* in the diffusion of cholera, and probably also of typhoid fever.

With regard to the extermination from a community of the parasite of infection in man, the two chief methods that have been adopted towards this end are:—

(1) That which was successfully employed in New Guinea by

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Professor Koch, viz., the searching out of all cases of Malaria and rendering these harmless by curing them with quinine. By this means he was able to greatly reduce Malaria in the on-coming season at Stephansort. In his fifth report to the German Imperial Health Bureau, Koch sums up as follows: "The results of our experiment, which has lasted nearly six months, have been so uniform and unequivocal that they cannot be regarded as accidental. We may assume that it is directly owing to the measures we have adopted that Malaria here has, in a comparatively short time, almost disappeared."

Such a method as this can obviously only be successfully adopted in a community which can be kept under observation, and is, therefore, not applicable to Africa.

In Africa, however, the second method is peculiarly adaptable.

(2) The segregation of Europeans from Natives. This method was primarily recommended by the Malaria Commission, and later, strongly adopted by the Liverpool School of Tropical Medicine Expedition to Nigeria.

This method is the outcome of observation upon the blood of native children. In New Guinea, Koch found that in nearly 100 per cent. of the native children examined, the parasite of infection was present. He also showed that with the advancement of age, immunity was produced, so that in the case of adults immunity was present, and the source of the infection was absent. Similar results were independently arrived at by the Malaria Commission amongst the native children of tropical Africa. In a paper on the "Prevention of Malaria" (Thompson Yates' Laboratories Report, vol. iii. part 2, p. 174), Dr. Christopher says: "With a knowledge of the ubiquity of native Malaria, the method of infection of Europeans becomes abundantly clear. The reputed unhealthiness or healthiness of stations is seen at once to be dependent on the proximity or non-proximity of native huts. The attack of Malaria after a tour up country, the Malaria at military stations like Prah-su, the abundance of Malaria on railways, are all explicable when the extraordinary condition of universal native infection is appreciated. It is evident that could Europeans avoid the close proximity of native huts they would do away with a very obvious and great source of infection. That they could avoid the neighbourhood of huts, no one who has studied the condition of life in Africa can doubt."

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It will be both interesting and instructive to see if, with the return of our troops from South Africa, there will be any increase in the number of indigenous cases of Malaria in this country. It is not improbable that, other conditions being suitable, a certain number of our local Mosquitoes will become infected by these men. I may say that up to the present time I am accredited with being the only observer in England who has found the malaria parasite in a case of Ague indigenous to this country: the case being that I have referred to as coming to the Norfolk and Norwich Hospital, from Acle, in the year 1897. A reference to this case will be found in the first number of the 'Journal of Hygiene,' 1901, p. 31. As it was of the greatest importance to decide whether or not the parasite was present in this case—one of Tertian Ague—I was anxious to get my opinion confirmed by an expert. I therefore sent one of the blood preparations I made from the case to Dr. Nuttall of Cambridge, who has paid particular attention to this subject, and I have had a good deal of correspondence with him about it. He very kindly undertook to re-stain and re-mount the specimen—a proceeding always attended with considerable risk—and in his last communication to me on the subject (dated March 4th, 1901) he says: "You will be pleased to hear that I have found malarial parasites in the film after re-staining it to-day. There is about one parasite to every 3-4 fields, and this time there is no doubt about it."

Summary.

(1) Malaria is now known to be caused by a parasite, which passes one cycle of its existence in the blood of man, who acts as the intermediate host; whilst the Mosquito plays the part of the definitive host for the other cycle of its life-history.

(2) Only certain Mosquitoes—those of the Anopheles species—have so far been shown to be capable of acting as the definitive host of this parasite.

(3) Man becomes infected with Malaria through the bite of the Mosquito, and up to the present time no other means of infection is known. It has been conclusively proved that in certain highly malarious districts, *e.g.*, the Roman Campagna, man can live without fear of contracting Malaria if he adopts such measures as will insure complete protection against Mosquitoes.

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(4) In England three species of the Anopheles are known to occur. *Anopheles maculipennis*, *A. bifurcatus*, and *A. nigripes*, but the *A. maculipennis* is by far the most common.

(5) According to historical and hearsay evidence there is no doubt that a disease known as Ague or Fen-Ague was prevalent in certain parts of England, chiefly in the low-lying, ill drained and marshy districts, up to about the middle of the last century. Its almost complete disappearance (except for occasional sporadic cases) at the present time may be attributed chiefly, though probably not entirely, to a more complete system of drainage in these districts, with a consequent diminution in the *number* of the Mosquitoes.

(6) There is now conclusive proof that this Fen-Ague in England is caused by a parasite of the same nature as that known to cause Malaria in other countries.

(7) One of the most effectual ways of getting rid of Malaria in any district is by an extermination of the Mosquitoes. This can be effected by doing away with their breeding-places, pools, swamps, lakes, &c., by effectual drainage, and by destroying the larvæ of the insects in the water.

XII.

METEOROLOGICAL NOTES, 1900.

(From observations taken at Bradestone House, Brundall, Norfolk.)

By Arthur W. Preston, F. R. Met. Soc.

Read 26th February, 1901.

January.

This was a damp, ungenial month, with a great preponderance of cloud and gloom. There was frequent rain, although the falls were at no time very heavy, and the absence of any drying power

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in the air made it generally humid and unhealthy. The mean temperature was about one degree above the average, but it was a colder month than in 1898 and 1899. There was but little snow, and the winds were generally quiet, except during the last week, when there were gales from the S.W. veering to W.N.W. on the 24th and 25th, and again from the N.E. on the 28th and 29th. The Aconites and Snowdrops commenced to bloom about the 8th and 24th respectively, or about a week earlier than in the previous year, and about a week later than in 1897 and 1898.

February.

The month entered with dark, damp weather, followed by drying N.E. winds from the 6th to the 10th, giving place to a period of frost and snow. On the 12th and 13th the thermometer fell to 18.8 and 18·4 degrees respectively in the screen, and to 9·5 and 11 degrees on the grass. The remainder of the month was rainy and milder. Barometric pressure was abnormally low throughout the month, and on the mean was lower than in any month since March, 1888. On the 19th the barometer, at 7 p.m., fell to 28.50 in., which was the same reading as had been recorded on the 29th of the previous December. It is somewhat singular that in an interval of but little over seven weeks two such low readings should have been registered, particularly as the barometer had not previously descended so low for over thirteen years.

March.

This was a uniformly cold month throughout, with scarcely a mild day. The thermometer reached 50 degrees and upwards on three days only, the highest reading having been 55.4 degrees, which is the lowest maximum recorded here for March for seventeen years past. The mean temperature was nearly 3 degrees under the average, but the month was not so cold as in 1887, 1888, and 1892. Snow fell on eight days, but the rainfall of the month was less than the mean. Vegetation made a late start, but at the end of the month the fruit trees began to show signs of a fine prospect, which was ultimately realized.

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April.

The month entered with unusually cold weather for so late in the season, with sharp frost, and on the 2nd snow fell heavily in large flakes. Temperature kept low generally until the 11th, after which it was fairly high for some days, increasing greatly from the 19th, and culminating with an abnormally warm day on the 21st, when the thermometer reached 75.4 degrees in the shade. This was the first of a series of singular outbursts of unusual heat, for which the year was remarkable. The month was generally a windy one. Very strong winds prevailed during the Easter holidays. An unusually severe thunderstorm, for so early in the season, broke over Norwich on the 5th. Commencing at 11.50 a.m., thunder and lightning were almost continuous until 3 p.m., accompanied by great darkness and torrents of rain.

May.

This was a cold month for the fifth year in succession. The earlier part of the month gave promise of a fine, warm time, but, after heavy rain on the 8th, the wind shifted to the N. and N.E. with a great reduction in temperature. There were, however, no severe frosts to injure the fine fruit prospects.

June.

This month was unsettled throughout, yet could hardly be called a wet month, the rainfall being under $2\frac{3}{4}$ in. Showers and thunder were, nevertheless, somewhat frequent, and but little really warm weather was experienced except during the second week, when some of the days were exceedingly hot and oppressive. Severe thunderstorms occurred on the night of the 12th and early morning of the 13th, the lightning being exceptionally frequent and brilliant. During these storms but 0.06 in. of rain fell at Brundall, whereas at East Dereham the fall amounted to 0.91 in., and at Pulham St. Mary to 1.60 in.

July.

Although the month entered with unsettled weather, on the 10th a sudden change to tropical conditions occurred, and which continued to the end of the month. While the previous summer

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gave us a long spell of fineness and great warmth, the intensity and oppressiveness of the heat of July, 1900, was considerably greater, in fact since 1868 there has been nothing like it. The thermometer exceeded 70 degrees daily during the twenty-one days; it was over 75 degrees on seventeen days, over 80 degrees on six days, and reached 86 degrees on the 24th, and 87.2 degrees on the 25th. The nights were correspondingly warm. During the six nights ending the 26th, the temperature did not once fall below 60 degrees, and on the 26th the minimum was as high as 63.2 degrees. The mean temperature of the week ending July 21st was 68.3 degrees, and that of the week ending July 28th was 69.7 degrees, or more than 8 degrees above the average. That of the month (65.0 degrees) was higher than in any July since 1876, or in any month since August, 1884. The rainfall of the month was 1.72 in., or over an inch deficient. Thunder occurred on several days, the most severe storm having been that of the evening of the 21st, which lasted till 3.30 a.m. on the 22nd. The lightning was very brilliant and almost incessant, and at times the reports of thunder were terrific. Such a storm has not been experienced here since 1892; but in Mid-Norfolk it was even more severe and accompanied by hail and a tremendous downpour of rain.

August.

The entrance of August was signalized by a most abrupt change in the weather; the heat wave breaking up and giving place to ten days of cold, rough, rainy weather such is rarely seen at this season, even in wet summers. The drop in temperature was about 27 degrees, and the first ten days of the month yielded no less than 3 inches of rain. Heavy gales occurred on the 4th and 6th, quite out of character with summer, and the August Bank Holiday will long be remembered for the wind and rain which accompanied it. On the 11th the weather improved and some fine days followed, giving place on the 21st to further thunder and rain. The total rainfall of the month was greatly in excess of the average. With us it was the wettest August since 1881, and the total which was 4.35 in. considerably exceeded the aggregate of the three previous Augusts. In some parts of Norfolk the fall exceeded 5½ inches. The mean temperature did not fall far short of the average, by reason of the nights being relatively warmer than the days.

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September.

This was an exceedingly fine, dry, and pleasant month, with much warmth at times. The mean temperature was slightly above the average, and above that of the previous September, although it fell short of those of the two previous years. It was, however, the third year in succession on which 80 degrees was reached in the same month. The rainfall was very deficient, in fact it was the driest September but two for thirty-five years past, the two exceptions having been 1895, when the total fall was 0.48 in., and 1898, when it was but 0.17 in.

October.

The mean temperature was 1.7 degrees above the average, and the rainfall was 0.79 in. deficient. A great outburst of heat occurred on the 9th, the thermometer reaching 75 degrees, a very unusual reading for October. There was but little rain during the first half of the month, but during the latter part rain fell almost daily. An almost entire absence of frost kept garden flowers in bloom to a late period. Lightning was seen on four days, and thunder was heard on two days. A gale from the north-west occurred in the early morning of the 27th.

November.

With the exception of two or three fine days in the second week, this was a damp, dreary, and dismal month throughout. Rain fell on twenty-five days out of the thirty, and from the 12th to the 30th there was only one day without rain. The falls were, however, so comparatively light that the month's rainfall was more than half an inch under the average. Temperature kept high throughout, the mean being nearly 3 degrees above the average.

December.

The month was exceedingly mild throughout, the mean temperature being almost identical with that of December, 1898, which had been the mildest for thirty years past. Temperature exceeded 50 degrees on fifteen days, and there were only four nights with frost (in screen). A tropical rain fell on the 30th, amounting to 1.23 in. in the twenty-four hours. This was the heaviest fall

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during the year, and has not been exceeded here since June, 1898; indeed there have been only two heavier falls recorded here during the last ten years. This fall exceeded an inch at nearly all the rainfall stations in the county. Owing to the mildness of the season, garden flowers remained in bloom until a very late period. On Christmas Day I counted no less than twenty-five different kinds of plants in bloom in my garden. The following is a list:—Cornflower (blue), Laurustinus, Polyanthus, Pansy, Double-white Stock, Primrose, Mezereon, Chrysanthemum, Jacobæa, Christmas Rose, Rose, Jasminum nudiflorum, Scarlet Geranium, Borago officinalis, Chrysanthemum segetum grandiflorum, Ivy, Sweet William, Wallflower, Violet, Eschscholtzia, White Clarkia, Galegia, Mignonette, White Arabis, Winter Aconite.

The Seasons.

The following Tables show the mean temperature and rainfall for the four seasons, together with those of the five previous years, and of a twenty-year approximate average. Winter comprises the three months, December to February inclusive; Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1895.	1896.	1897.	1898.	1899.	1900.	20-year average.	Departure of 1900 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	34.7	39.6	38.3	41.3	42.6	37.4	37.8	— 0.4
Spring ...	47.6	48.0	46.9	45.8	46.2	45.3	46.2	— 0.9
Summer ..	60.4	61.1	61.9	59.7	61.9	61.6	60.2	+ 1.4
Autumn ...	51.4	48.5	50.3	54.0	51.2	51.6	49.5	+ 2.1
Year	48.4	49.3	49.5	50.5	49.8	49.6	48.4	+ 1.2

RAINFALL.

Seasons.	1895.	1896.	1897.	1898.	1899.	1900.	20-year average	Departure of 1900 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	7.35	3.28	7.86	4.11	5.82	7.42	6.02	+ 1.40
Spring ...	4.15	5.18	5.05	6.18	6.84	4.26	5.21	— 0.95
Summer ...	7.51	4.88	4.17	6.90	3.52	8.77	7.17	+ 1.60
Autumn ...	7.13	8.49	6.42	5.65	8.31	5.32	8.50	— 3.19
Year ...	24.91	23.28	22.07	23.33	23.94	26.99	26.90	+ 0.09

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It will be seen from the above that the Winter and Spring were colder than the average, although the deficiency was not great. The Summer, notwithstanding the great heat of July, did not result on the mean in being quite so warm as in 1899 or in 1897. This was due to the abnormally cold weather in August. The Autumn was the warmest but one of the series. Rainfall was slightly excessive in the Winter and Summer, slightly deficient in the Spring, and largely deficient in the Autumn.

The Year.

A rather cold and protracted Winter was followed by a later Spring than usual, the month of May being particularly cold. Owing to the fineness of the previous season the fruit trees had become well set with blossom buds, and the lateness of the Spring retarded the blooming season, and when once the fine show of blossom expanded it received no check. One of the finest crops of fruit known for many years past resulted. Wall fruit was very abundant, and the Plum crop in some places was so heavy that the markets became glutted, and the fruit almost unsaleable. Apples and Pears were a magnificent crop. The sudden outbursts of abnormal heat in April, July, September, and October, were very remarkable, occurring as they did in a season which gave no continued great heat. The maxima of 75 degrees in both April and October were almost as notable as the outburst in July, and it is also worthy of remark that the heat-wave of July came almost exactly midway between the two shorter periods of warmth in April and October. While the previous Summer gave us three and a half months of almost continuous heat and fineness, the hot weather in the Summer of 1900 lasted but three weeks, during which there were warmer days than during all the previous long and protracted Summer. The sudden change to cold and wet with the advent of August, just as harvest was commencing, was a most unpleasant and unlooked for sequel. The season was very mild to the end of the year, with much humidity, no snow, and but little frost. There was a great prevalence of thunderstorms during the Summer, some of them being unusually severe. While the rainfall of the year was in close agreement with the average, the number of days on which rain fell was greater than for many years past.

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Month.	Barometer.					Thermometer.					Hygrometer.	Cloud.	Rainfall.		Wind.								
	Highest.	Date.	Lowest.	Date.	Mean.	Highest.	Date.	Lowest.	Date.	Mean.	Mean Relative Humidity, 9 a.m.	Estimated proportion	Inches.	No. of days.	Direction.								Mean estimated force
															N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W	
Jan. .	30.45	12	29.36	3	29.906	50.2°	24	26.0°	14	38.6°	93	7.6	2.74	23	1	5	0	1	6	10	6	2	3.0
Feb. .	30.08	14	28.51	19	29.575	57.0	24	18.4	13	37.6	93	7.4	2.92	19	1	5	4	2	3	5	5	3	3.2
March	30.54	13	29.21	19	30.009	55.4	12	23.2	18	38.4	87	7.1	1.09	22	7	8	8	0	2	1	0	5	3.1
April	30.58	20	29.24	4	29.965	75.4	21	28.0	1	46.9	75	6.3	1.30	15	1	5	1	2	1	2	8	10	3.2
May .	30.31	29,30	29.53	7	29.979	71.0	6	33.0	11	50.7	79	6.7	1.87	15	5	6	1	1	6	5	2	5	3.5
June .	30.22	14	29.56	25	29.932	82.2	12	45.8	27	59.3	83	6.5	2.70	20	1	5	0	2	2	11	3	6	2.8
July .	30.29	17	29.59	1	30.008	87.2	25	46.8	8	65.1	76	4.5	1.72	12	1	0	1	3	4	7	5	10	2.4
Aug. .	30.41	30	29.19	3	29.946	79.0	13	45.2	31	60.3	81	6.3	4.35	18	2	9	3	1	4	4	4	4	3.4
Sept. .	30.52	12,13	29.60	27	30.128	80.0	16	41.2	25	58.3	85	5.9	0.89	11	2	1	1	3	1	8	6	8	2.4
Oct. .	30.53	22	29.18	27	29.945	75.0	9	31.5	4	50.7	85	6.6	2.26	20	0	2	0	0	5	11	3	10	2.9
Nov. .	30.37	18	29.27	16	29.754	60.6	1	28.0	11	45.7	93	7.3	2.17	25	3	4	1	7	4	6	4	1	2.5
Dec. .	30.46	16	28.97	28	29.884	57.0	12	25.8	23	44.2	92	7.2	2.98	22	0	2	1	0	4	13	8	3	3.3
Means					29.919					49.6	85	6.6											2.9
Extremes & Totals	30.58	April 20th	28.51	Feb. 19th		87.2	July 25th	18.4	Feb. 13th				26.99	222	24	52	21	22	42	83	54	67	

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XIII.

A PRELIMINARY LIST OF NORFOLK MOSSES.

By H. N. Dixon, M.A., F.L.S.,

Hon. Mem. Caradoc and Severn Valley Field Club.

(Communicated by H. D. Geldart.)

Read 26th February, 1901.

The sources from which the following list has been drawn up are as follows:—

1. The list of Mosses in the 'Sketch of the Natural History of Yarmouth and its Neighbourhood,' by C. & J. Paget, 1834.

2. The Mosses in the Rev. Geo. Munford's 'List of the Botanical Productions known or reported to inhabit the County of Norfolk,' 1864.

3. A list of Mosses and Hepatics in Mason's 'History of Norfolk,' compiled by Miss A. M. Barnard.

4. A MS. list of Mosses collected mostly in East Norfolk (v.-c. 27) in 1898, 1899, and 1900, by Mr. W. H. Burrell, comprising about fifty species. These were submitted to Mr. E. Chas. Horrell for confirmation, and the determinations of the Sphagna are by him.

5. A collection made for me in 1900 by Mr. J. W. Bodger, principally from Hunstanton and the neighbourhood, containing about thirty species.

6. A collection of about fifty species, similarly made by Mr. E. M. Holmes, in 1900, from Holt, Hunstanton, etc.

7. Various scattered records, as in Smith's 'English Flora,' vol. v., Braithwaite's 'British Moss Flora,' Mr. Skepper's Herbarium (per Rev. E. N. Bloomfield), etc.

The district covered by the Pagets' 'Sketch' includes portions of both Norfolk and Suffolk, approximately one-third of the area belonging to the latter county. Localities are given for a part

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of the species, and such of course present no difficulty. Where no localities are given for a species except Suffolk ones, I have only included it when these are followed by "etc." When, again, no localities are designated, I have only included the species if it is described as "common," "abundant," etc. In such cases it may fairly be presumed that some one or other of the habitats noted occurred within the Norfolk portion of the district.

More important difficulties arise in the case of Munford's list. In his introduction he states that he is greatly indebted to the lists in Messrs. Pagets' 'Sketch.' As, however, he does not distinguish the citations from that list from records derived from other sources, and as it is clear from internal evidence that he cites *all* Pagets' records without omitting those that really belong to Suffolk alone, it has been necessary to disregard all his records of species from the Eastern Division which occur in the Yarmouth list, since they may be, and in many cases undoubtedly are, simply duplications of those records. Munford's list, therefore, adds little to our knowledge of the Mosses of the Eastern Division, and the records he gives from the Western are but few. It also unfortunately happens that his Central Division, divided into northern and southern districts, overlaps both East and West Norfolk, vice-counties 27 and 28 according to Watson's system, which it will be remembered are divided from one another by the arbitrary line of the first meridian east of Greenwich. All these records have therefore to be omitted from the vice-comital distribution.

Miss Barnard's list is, like Munford's, unlocalised. There is, however, internal evidence to show that she has not copied indiscriminately the records given in Pagets' List, whether belonging to Norfolk or not. Thus, for instance, *Splachnum ampullaceum* and *Hypnum stramineum*, recorded in the latter for Suffolk localities alone, are omitted from Miss Barnard's list. It seems reasonable, therefore, to infer that when such species are included in her list it is upon some other evidence than Pagets' 'Sketch,' and I have, in the few instances in which this is the case, accepted the records. They do not, however, indicate the vice-county in which the plant occurred.

I have not attempted to give all the localities from which I have records, except in the case of the rarer species. I have for

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the most part contented myself with a single station or record for each of the two vice-counties (in the case of species recorded from both). The recorded stations are at present so meagre, that no good end would be served, it would indeed be misleading, to give what might seem an attempt at an exhaustive list of localities. It must be borne in mind that but a fragmentary portion of the county is covered by these records, and of that portion scarcely any district can be considered to have been exhaustively worked.

The total number of species and sub-species contained in the following list will be found to amount to about 170. There can be no doubt that a more exhaustive examination will result in the addition of a considerable number of species to the county list, and in all probability the greater number of the species here recorded from one of the vice-counties alone will be ultimately found to occur in both.

Most of the Sphagna have been submitted to Mr. E. Charles Horrell, who has determined them in accordance with the views of Dr. Warnstorf (v. Journ. of Bot., 1900, May—Dec.). All records which have not been so submitted I have distinguished by the addition of "aggregate."

It is greatly to be hoped that the Mosses may receive further study in a county which has been so conspicuous for bryological investigation in the past. It has been chiefly in the hope of encouraging and providing a basis for such study that the scattered records have been gathered together in this paper. I have to express my thanks to the gentlemen mentioned at the outset for the assistance kindly rendered by them in various ways.

Abbreviations.

27 = East Norfolk. 28 = West Norfolk. *Pag.* = Paget. *Mun.* = Munford. (Herb. Skepper) = Skepper's Herbarium. O. B. G. = Old Botanists' Guide.

Sphagnaceæ.

Sphagnum cymbifolium, Ehrh. (aggreg.) 27 (Pag.). 28 (Mun.). Dersingham (Bodger).

,, cymbifolium, Warnst. (segreg.) 27 (Burrell).

,, papillosum, Lindb., var. normale, Warnst. 27. Holt (Holmes).

,, medium, Limpr., var. violascens, Warnst. 27. Holt (Holmes).

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SPHAGNUM TENELLUM, Ehrh. (aggreg.) 27. Holt (Holmes). 28. Dersingham (Bodger).

„ SUBSECUNDUM, Nees., var. CONTORTUM, Schimp. (aggreg.) 28. Dersingham (Bodger).

„ SQUARROSUM, Pers. (aggreg.) 27 (Pag.).

„ SQUARROSUM, Pers., var. SUBSQUARROSUM, Russ. 27. Holt (Holmes).

„ ACUTIFOLIUM, Ehrh. (aggreg.) 27 (Pag.). 28. Dersingham (Bodger).

„ SUBNITENS, Russ. and Warnst., var. VIOLASCENS, Warnst. 27 (Burrell).

„ RUBELLUM, Warnst. 27. Holt (Holmes).

„ PARVIFOLIUM, Warnst. 27 (Burrell).

„ INTERMEDIUM, Hoffm. (aggreg.) 28. Dersingham (Bodger).

„ CUSPIDATUM, Ehrh. (aggreg.) 28. Dersingham (Bodger).

POLYTRICHACEÆ.

CATHARINEA UNDULATA, W. and M. 27 (Pag.). 28 (Mun.).

POLYTRICHUM NANUM, Neck. 27, "Often with *aloides*" (Pag.). Munford records it from both districts of the central division. Herb. Skepper.

„ ALOIDES, Hedw. 27 (Pag.). 28 (Mun.). The variety *Dicksoni*, Wallm. is recorded from "near Yarmouth (Dickson)" (Braithw. Brit. Moss Fl. vol. i. 48), but this leaves a doubt as to which county can claim the record. Very probably the reference is to the localities "Lound and Fritton," given in the 'Old Botanists' Guide,' etc., which are in Suffolk.

„ URNIGERUM, L. 27. "Gillingham, Norfolk; D. Turner, Esq." (Hooker, in Smith's Eng. Flora, vol. v.)

„ PILIFERUM, Schreb. 27 (Pag.). 28 (Mun.).

„ JUNIPERINUM, Willd. 27 (Burrell). 28. Dersingham (Bodger).

„ STRICTUM, Banks. 28. Dersingham Moor; Smith (O. B. G.).

„ FORMOSUM, Hedw. 27. Munford records this species from the Eastern and both districts of the Central

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Division. Pagets' "*P. commune*, var. β," which he describes as abundant in the neighbourhood of Yarmouth, may be assumed to refer to this plant, although the name was at that time applied also to *P. gracile*, Dicks., which at that period had not been clearly distinguished from the present species. 28. Dersingham (Bodger).

POLYTRICHUM COMMUNE, L. 27 (Pag.). 28. Dersingham (Bodger).

[P. GRACILE, Dicks., is recorded in O. B. G., but the plant was very young, and the record must be held doubtful].

BUXBAUMIACEÆ.

BUXBAUMIA APHYLLA, L. 27. "First discovered at Sprowston near Norwich, in a Fir plantation" (Hooker in Smith's Eng. Fl. vol. v.). This curious and interesting plant was found at Sprowston, for the first time in Britain, by Sir W. J. Hooker, in December, 1806.

DICRANACEÆ.

PLEURIDIUM AXILLARE, Lindb. 27. Wet places, North Denes (Pag.).

„ SUBULATUM, Raben. 27 (Pag.).

CERATODON PURPUREUS, Brid. 27 (Pag.). 28 (Mun.).

DICRANELLA HETEROMALLA, Schimp. 27 (Burrell). 28 (Mun.).

„ CERVICULATA, Schimp. 27. "Not uncommon" (Pag.).

„ VARIA, Schimp. 27. "Gravel-pit at Thorpe by Norwich; Mr. Dickson" (O. B. G.).

CAMPYLOPUS PYRIFORMIS, Brid. 27. Mousehold Heath (Herb. Skepper). This is labelled *Dicranum flexuosum* (= *C. flexuosus*, Brid.) in Mr. Skepper's Herbarium, but the Rev. J. Ferguson determined it to be undoubtedly *C. pyriformis*. It is probable, therefore, that the records for *D. flexuosum* in Pagets' list should be transferred to this species. The var. *nigro-viride* recorded in that list from "damp muddy spots; but rare" may possibly belong to the true *C. flexuosus* (it is scarcely probable that it would be *C. atrovirens*, De Not, to which the name has also been applied); but in the absence

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of specimens, and of clearer localisation, it can hardly be included here.

CAMPYLOPUS BREVIPILUS, B. and S. 28. Wolferton (Holmes).

DICRANOWEISIA CIRRATA, Lindb. 27 (Pag.).

DICRANUM BONJEANI, De Not. 27 (Burrell). Edgefield Heath, Holt, with a form nearly approaching the var. *rugifolium*, Bosw. (Holmes).

,, SCOPARIUM, Hedw. 27 (Pag.). A short, dwarfed form near Holt (Holmes).

LEUCOBRYUM GLAUCUM, Schimp. 27. Caistor Marrams (Pag.). Edgefield Heath, Holt; a small, compact form, which, however, cannot be referred to *L. albidum*, Lindb. (Holmes).

FISSIDENTACEÆ.

FISSIDENS BRYOIDES, Hedw. 27 (Pag.).

,, ADIANTOIDES, Hedw. 27. Holt c. fr. (Holmes).

,, DECIPIENS, De Not. 27 (Burrell).

,, TAXIFOLIUS, Hedw. 27 (Burrell).

GRIMMIACEÆ.

[GRIMMIA APOCARPA, Hedw. Munford records this common species from the Eastern Division, but the record is probably derived from Pagets' list, where the only locality given is a Suffolk one.]

,, PULVINATA, Smith. 27 (Pag.). 28. Castle Rising (Bodger).

RHACOMITRIUM CANESCENS, Brid. 27. "Sand-hills by North Battery" (Pag). 28. "Fairly abundant on the White Hills near North Wootton Common" (Holmes).

,, LANUGINOSUM, Brid. "Rare on heaths in the plains; as in Norfolk, Rev. James Layton" (Hooker in Smith's Eng. Flora, vol. v. p. 37, and Muscol. Brit., 2nd ed., p. 106). There is no other record extant of this species, and its inclusion in the Norfolk Flora must be allowed to rest on a somewhat precarious foundation. On the one hand it seems scarcely likely that Hooker and Taylor (and later on Hooker again) would have admitted a record of a confessedly unusual occurrence, except on what

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appeared to them reliable evidence; nor are the two plants (*R. lanuginosum* and *R. canescens*) such as are very liable to be confused. On the other hand *Rhac. lanuginosum* has not been again recorded, nor is any Norfolk specimen known to exist. *Rhac. lanuginosum* has indeed been recorded in Suffolk erroneously for *Rhac. canescens*, but it is not quite clear that this constitutes a valid argument for supposing the same to have been the case with the record of the Norfolk plant.

TORTULACEÆ.

ACAULON MUTICUM, C. Müll. 27 (Mun.).

PHASCUM CUSPIDATUM, Schreb. 27 (Pag.).

„ „ var. PILIFERUM, H. and T. 27. "Near the Oil-houses, South Denes; Mr. Turner" (Pag.).

POTTIA RECTA, Mitt. 27 (Burrell). "Near Norwich, D. T." (O. B. G.).

„ BRYOIDES, Mitt. 27. "Norwich! (Valentine)," (Braithw. Brit. Moss Flora, vol. i., 195).

„ TRUNCATULA, Lindb. 27 (Pag.).

„ INTERMEDIA, Fürnr. 27 (Pag.). "Common on banks about Yarmouth and Norwich, D. T." (O. B. G.).

„ MINUTULA, Fürnr. 27. Sheringham (Holmes).

„ STARKEANA, C. Müll. 27. "Acle, Mr. Turner" (Pag.).

„ LANCEOLATA, C. Müll. Munford records this from the southern district of the Central Division.

„ HEIMII, Fürnr. 27. "Breydon wall and marshes" (Pag.). Included in Miss Barnard's list, but probably in Suffolk. A second locality near Yarmouth is given, however, in O. B. G., which is actually in Norfolk, viz., "On Yarmouth Denes in wet ground by the Oil-houses."

TORTULA PUSILLA, Mitt. 27. Munford records this from the Eastern and South-Central Divisions.

„ RIGIDA, Schrad. ["Walls and clay-banks near Yarmouth" (Pag.). This leaves the exact locality doubtful, and the species should scarcely be included without fresh evidence.]

„ ALOIDES, De Not. Munford's reference is probably to Pagets' list, where the locality given (Burgh Castle)

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is in Suffolk. There are, however, Norfolk specimens in Mr. Skepper's Herbarium, viz., "On a bank about three miles from Norwich on the Yarmouth Road; Dr. Smith." "On Heydon Church; Rev. H. Bryant." Both in v.-c. 27.

TORTULA MARGINATA, Spruce. "Norfolk (Eagle)" (Braithw. Brit. Moss Flora, vol. i. 216).

„ MURALIS, Hedw. 27 (Pag.). 28. Hunstanton (Bodger).

„ SUBULATA, Hedw. 27 (Pag.). Holt (Holmes). 28 (Mun.).

„ RURALIS, Ehrh. 27 (Pag.). 28. Sandringham, a stunted form resembling *T. intermedia*, Berk. (Holmes).

„ RURALIFORMIS, Dixon. 27. Cromer (Dixon). 28. Hunstanton (Bodger); do. c. fr. (Holmes).

„ PAPILLOSA, Wils. 27. Mundesley (Holmes).

BARBULA RUBELLA, Mitt. [27. Munford records this very common plant from the Eastern Division.]

„ LURIDA, Lindb. 28. Wall, Titchwell (Holmes).

„ TOPHACEA, Mitt. 27. Mundesley (Holmes).

„ FALLAX, Hedw. 27 (Pag.).

„ RIGIDULA, Mitt. 28. Castle Rising (Bodger).

„ VINEALIS, Brid. 27. Stalham Broad (Holmes). 28. Hunstanton (Bodger).

„ REVOLUTA, Brid. 28. Wall, Titchwell (Holmes). Miss Barnard includes this in her list.

„ UNGUICULATA, Hedw. 27 (Pag.). 28. Hunstanton (Bodger).

WEISIA CRISPA, Mitt. Munford records this species from the South-Central Division.

„ VIRIDULA, Hedw. 27 (Pag.).

TRICHOSTOMUM FLAVOVIRENS, Bruch. 28. Sandhills, Hunstanton (Holmes). Mr. Holmes found, in addition to the ordinary form, a smaller one, with narrower leaves and smaller cells.

ENCALYPTACEÆ.

ENCALYPTA VULGARIS, Hedw. Included in Miss Barnard's list.

ORTHOTRICHACEÆ.

ZYGODON VIRIDISSIMUS, R. Br. 27 (Pag.). 28. Sandringham (Holmes).

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ULOTA CRISPA, Brid. 27. "Not uncommon" (Pag.). 28 (Mun.).
,, PHYLLANTHA, Brid. 27. Holt (Holmes).
[,, HUTCHINSIÆ, Hamm. 27. Recorded by Munford from the Eastern Division, but it does not seem a very likely plant to occur here.]
ORTHOTRICHUM CUPULATUM, Hoffm. 27. Recorded by Munford from both the Eastern and the South-Central Divisions.
,, LEIOCARPUM, B. & S. 27 (Pag.). Munford records from both districts of the Central Division.
,, AFFINE, Schrad. 27 (Pag.). Holt (Holmes).
,, DIAPHANUM, Schrad. 27 (Pag.). Holt (Holmes).
,, LYELLII, Hook. and Tayl. 27 (W. H. Burrell).
,, TENELLUM, Bruch. 27 and 28 (W. H. Burrell).

FUNARIACEÆ.

EPHEMERUM SERRATUM, Hmpe. "Acle woods and fields, etc." (Pag.).
PHYSCOMITRELLA PATENS, B. & S. 27. "Acle, Mr. Borrer, 1809" (Pag.).
PHYSCOMITRIUM PYRIFORME, Brid. 27. "Belton, etc." (Pag.).
FUNARIA FASCICULARIS, Schimp. 27. Recorded by Munford from both the Eastern and South-Central Divisions.
,, HYGROMETRICA, Sibth. 27 (Pag.). Mundesley (Holmes).
,, MICROSTOMA, B. and S. A very interesting plant was gathered by Mr. Burrell at Beeston Regis (v.-c. 27) in 1898, about which some doubt has arisen as to whether it should be referred to *Funaria hygrometrica*, one of the commonest, or to *F. microstoma*, one of the rarest of British Mosses. In a letter to the writer, Mr. E. Ch. Horrell, to whom it was at first submitted, says: "Inner peristome very thin and much smaller than in *F. hygrometrica*, but is larger than that of *F. microstoma* as figured in your Handbook and in the Bry. Eur., and of different appearance. Spores average 22 μ; Limpricht gives *hygrometrica* 13—16 μ, and *microstoma* 26—32 μ." Careful examination by other bryologists confirmed these observations. The conclusion seems to be forced upon us that the Norfolk plant is intermediate between the two species, though undoubtedly nearer *F. microstoma;* and this view is supported by a somewhat similar plant gathered by Mr. E. M. Holmes on Copthorne Common, Sussex, in the same year; this however was decidedly nearer to *F. hygrometrica*, though

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presenting certain characters indicating an approach to the rarer species. It is interesting in the taxonomic study of Mosses to find two forms so clearly uniting such apparently well-marked species as *F. hygrometrica* and *F. microstoma*. Attention should also be called to the relation between the size of the spores and the development of the peristome which obtains here and finds an illustration in at least several other cases; the size of the spores increasing as the development of the peristome decreases. Thus several of the varieties of *Weisia viridula* in which the peristome is poorly developed have markedly larger spores than in the type. In Bryum also, the species with most highly developed peristome (Eu-bryum), as a rule have much smaller spores than those of the sections Cladodium, etc., where a less highly organised peristome is almost always associated with a larger size of spores. The prevalence of large spores among the Cleistocarpous Mosses is a further example.

MEESIACEÆ.

AMBLYODON DEALBATUS, Beauv. Munford records this from the North-Central Division. It was also recorded from Suffolk at an early date, by Eagle. 27. St. Faith's Bogs (near Norwich), Mr. Crowe (O. B. G.).

AULACOMNIUM PALUSTRE, Schwägr. 27 (Pag.). Holt (Holmes). 28. Dersingham, c. fr. (Bodger).

SPLACHNACEÆ.

SPLACHNUM AMPULLACEUM, L. 27. Munford records this plant from the Eastern, and from both districts of the Central Division. It is probably much less common now than formerly. "Geldeston Fen (Mr. Stowe)," (O. B. G.).

BARTRAMIACEÆ.

BARTRAMIA POMIFORMIS, Hedw. 27 (Burrell).

PHILONOTIS FONTANA, Brid. 27 (Burrell). Edgefield Heath, Holt, with a falcate-leaved form (Holmes).

„ CÆSPITOSA, Wils. 27. Holt. A very interesting plant sent by Mr. Holmes proved to be this species or sub-species. It is even more marked than some of Wilson's own specimens in the

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acuteness of the perigonial bracts, whilst differing from *P. marchica*, Brid., in the direction of the bracts and other points. The record is of special interest as the perigonia, without which the plant can scarcely be determined with certainty, are rarely found.

BRYACEÆ.

WEBERA NUTANS, Hedw. 27 (Pag.). "Acle; D. T." (O. B. G.). 28 Dersingham (Bodger).

[„ CARNEA, Schimp. Munford records this perhaps on the authority of Pagets' list, where, however, the only localities given are Suffolk ones.]

„ PENDULUM, Schimp. 28. A specimen sent to me from Hunstanton, by Mr. A. B. Jackson, gathered by him in 1900, proved to belong here, with the characteristic peristome very strongly marked.

„ INCLINATUM, Bland. 28. Sandringham (Holmes).

„ TURBINATUM, Schwägr. [27. "Not uncommon" (Pag.).] 28. "Fakenham, Norfolk, G. Fitt, 1849" (Braithw., B. M. Fl., vol. ii. 186).

„ *PSEUDO-TRIQUETRUM, Schwägr. 27 (Pag.). Holt (Holmes).

„ ATROPURPUREUM, W. and M. 27 (Mun.).

„ CÆSPITICIUM, L. 27 (Pag.). 28 (Mun.).

„ CAPILLARE, L. 27 (Pag.). 28. Hunstanton (Bodger).

„ ARGENTEUM, L. 27 (Pag.). 28 (Mun.).

„ ROSEUM, Schreb. 27 (Mun.) Burrell. Mousehold Heath (Herb. Skepper).

MNIUM AFFINE, var. RUGICUM, B. and S. 27. Holt (Holmes).

„ CUSPIDATUM, Hedw. 27 (Pag.). Munford records it also from both districts of the Central Division.

„ ROSTRATUM, Schrad. 28. Hunstanton (Bodger).

„ UNDULATUM, L. 27. "Rather rare, and very seldom bearing fruit" (Pag.).

„ HORNUM, L. 27 (Pag.). 28. Dersingham Wood (Bodger).

„ SUBGLOBOSUM, B. and S. 27. Holt (Holmes).

* The record of this plant, as given in Pagets' list, must be considered doubtful, as the identity of the plants with Schwaegrichen's species is far from certain; Mr. Skepper's specimens, so named, were *B. bimum* and *B. pallens*.

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FONTINALACEÆ.

FONTINALIS ANTIPYRETICA, L. 27 (Pag.).

CRYPHÆACEÆ.

CRYPHÆA HETEROMALLA, Mohr. 27 (Pag.). "Ormesby; Mr. Stowe, Old Buckenham; D. T." (O. B. G.).

NECKERACEÆ.

NECKERA COMPLANATA, Hübn. 27 (Pag.). (Herb. Skepper.)

HOMALIA TRICHOMANOIDES, Brid. 27 (Pag.).

HOOKERIACEÆ.

PTERYGOPHYLLUM LUCENS, Brid. Munford records from North-Central Division.

LEUCODONTACEÆ.

LEUCODON SCIUROIDES, Schwägr. 27 (Mun.).

ANTITRICHIA CURTIPENDULA, Brid. 27 (Mun.). East and North-Central Divisions. "Very abundant on Yarmouth Denes by the North Battery, but always barren, D. T." (O. B. G.).

[POROTRICHUM ALOPECURUM, Mitt. This needs a fresh record, as the only one hitherto is Munford's "E," whereas the locality given in Pagets' list is Burgh Castle in Suffolk.]

LESKEACEÆ.

ANOMODON VITICULOSUS, H. and T. 27 (Pag.).

THUIDIUM TAMARISCINUM, B. and S. 27 (Pag.). 28 (Mun.).

HYPNACEÆ.

CLIMACIUM DENDROIDES, W. and M. 27. "North Denes, very rarely bearing fruit" (Pag.). 28. Abundant near Sandringham (Holmes).

ISOTHECIUM MYURUM, Brid. 27 (Pag.).

PLEUROPUS SERICEUS, Dixon. 27 (Pag.). 28. Castle Rising (Bodger).

CAMPTOTHECIUM LUTESCENS, B. and S. 27. North Denes, Marrams, etc. (Pag). 28 (Mun.).

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CAMPTOTHECIUM NITENS, Schimp. 27. "Acle Marshes, near the wood, Mr. Turner" (Pag.). A handsome species, now extremely rare in Britain south of the Scotch border, but at one time extremely abundant in some parts of England, as is proved by the large quantities found in some Peat deposits.

BRACHYTHECIUM GLAREOSUM, B. and S. 27 (Burrell).

" ALBICANS, B. and S. 27 (Pag.). 28. Wells (Holmes).

" RUTABULUM, B. and S. 27 (Pag.). 28. Castle Rising (Bodger).

" VELUTINUM, B. and S. 27 (Pag.).

" PLUMOSUM, B. and S. Munford records this from the Eastern Division, but it does not appear to me very probable that it occurs in Norfolk, as it is a plant almost entirely confined to rocks in the neighbourhood of water. It certainly needs confirmation.

" PURUM, Dixon. 27 (Pag.). 28 (Mun.).

EURHYNCHIUM PILIFERUM, B. and S. 27 (Pag.).

" PRÆLONGUM (L.). 27 (Pag.). 28. Snettisham Wood (Bodger).

" SWARTZII, Hobk. 28. Hunstanton (Bodger).

" ABBREVIATUM, Schimp. 27. Mundesley (Holmes). A rather small form, but undoubtedly this species.

" PUMILUM, Schimp. 27. Mundesley (Holmes).

" TENELLUM, Milde. 27. Clippesby Church (Pag.). Munford records from both North-Central and South-Central Divisions.

" STRIATUM, B. and S. 27 (Pag.).

" MURALE, Milde. 28. Castle Rising (Bodger).

" CONFERTUM, Milde. 27 (Pag.). 28. Snettisham Wood (Bodger).

" RUSCIFORME, Milde. 27 (Pag.).

PLAGIOTHECIUM DENTICULATUM, B and S. 27 (Pag.). 28. Dersingham Wood (Bodger).

" UNDULATUM, B. and S. 27 (W. H. Burrell); (Herb. Skepper).

AMBLYSTEGIUM SERPENS, B. and S. 27 (Pag.). *H. subtile* (O. B. G.) belongs here.

" FILICINUM, De Not. 27. Holt (Holmes).

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HYPNUM RIPARIUM, L. 27 (Pag.).

„ STELLATUM, Schreb. 27. Edgefield Heath, Holt (Holmes). Holt c. fr. (Holmes). Munford records it from all but the Western Division.

„ POLYGAMUM var. MINUS, Schimp. 27. Sheringham (Holmes). Among the Mosses sent me by Mr. Holmes was one collected at Sheringham, closely resembling *H. chrysophyllum*, but showing only very faint traces of a nerve. I sent this to Mr. Bagnall, who recognised it as *H. polygamum* var. *minus*, Schimp., a variety hitherto unrecorded from the British Isles. There is a very close resemblance between some of the smaller varieties of *H. polygamum* and of *H. stellatum*, and between these again and *H. chrysophyllum*, but Mr. Bagnall found the flowers clustered, and both synoicous and autoicous, a characteristic feature of *H. polygamum*, being indeed that on which its specific name is founded, and by which it is clearly separated from the other two plants. The variety has been found in several stations in Mid-Europe, and extends as far north as Spitzbergen.

„ ADUNCUM, Hedw. 27 (Pag.). 28. Mr. Holmes and Sir James Stirling gathered a form or variety with shorter, very broad leaves, and short areolation.

„ LYCOPODIOIDES, Schwägr. 27. "St. Faith's bogs, Norwich and Yarmouth (Turner)" (Braithw. Brit. M. Fl. vol. iii., 45).

„ FLUITANS, L. 28. Dersingham; Grimston (Holmes); var. FALCATUM, Schimp. 28. Roydon Common (E. M. Holmes and Sir Jas. Stirling).

„ EXANNULATUM, Gümb. 28. North Wootton Common (E. M. Holmes and Sir Jas. Stirling).

„ REVOLVENS, Swartz. 27. Royden Fen (Diss), c.fr. (Holmes).

„ INTERMEDIUM, Lindb. 27. Holt (Holmes).

„ VERNICOSUM, Lindb. 28. Beeston Bog (Jas. Saunders).

„ UNCINATUM, Hedw. 27. "Not uncommon" (Pag.).

„ FALCATUM, Brid. 27 (Burrell). Holt (Holmes). A small form showing some characters of both *H. falcatum*

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and *H. commutatum*. 28. Beeston Bog (Jas. Saunders).

HYPNUM CUPRESSIFORME, L. 27 (Pag.). 28. Wells (Holmes). Recorded from all divisions in Munford's list. *H. nigro-viride*, Dicks., Yarmouth Denes (O.B.G.), belongs here.

„ CUPRESSIFORME var. FILIFORME, Brid. 27 (Burrell).

„ „ „ RESUPINATUM, Schimp. 28. Hunstanton (Bodger).

„ CUPRESSIFORME var. ERICETORUM, B. and S. 27. (W. H. Burrell).

„ CUPRESSIFORME var. TECTORUM, Brid. (Saunders).

„ MOLLUSCUM, Hedw. 27. Holt (Holmes).

„ PALUSTRE, L. Munford records it from all four divisions of the county. It is not a species that one would expect to be common in East Anglia.

„ SCORPIOIDES, L. 27. "Not uncommon" (Pag.). North and South districts of the Central Division (Mun.). (Burrell). Holt; Royden Fen, near Diss (Holmes).

„ CORDIFOLIUM, Hedw. 27 (Pag.). *Hypnum cordifolium* and *H. giganteum* have been much confused, and it would be desirable that the present species should be verified as a Norfolk plant.

„ GIGANTEUM, Schimp. 27 (Burrell). Holt (Holmes).

„ CUSPIDATUM, L. 27. Holt (Holmes).

„ STRAMINEUM, Dicks. 27. Holt (Holmes).

„ SCHREBERI, Willd. 27 (Burrell). 28. Dersingham (Bodger).

HYLOCOMIUM SPLENDENS, B. and S. 27 (Pag.). Holt, with a slender form (Holmes). Muckle Moor c. fr. (Herb. Skepper). Muckle Moor is probably equivalent to Muckle Hill (v.-c. 27).

„ TRIQUETRUM, B. & S. 27 (Pag.). 28. Hunstanton (Bodger).

„ SQUARROSUM, B. and S. 27 (Pag.).

„ RUGOSUM, De Not. 28. "Heathy places near Thetford, F. K. Eagle, Esq." (Hooker in Smith's Eng. Flora, vol. v.). Munford records it from the South-Central Division, which would probably refer to the same localities.

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XIV.

A LIST OF SUFFOLK MOSSES.

By Rev. E. N. Bloomfield, M.A., F.E.S.

Read 26th February, 1901.

As no complete list of the Moss Flora of Norfolk has hitherto been given, I had thought it might be well to prepare a list of the Mosses of Suffolk, which doubtless will for the most part be found to occur also in Norfolk. On writing to Mr. H. N. Dixon, however, I found he was preparing a list of Norfolk Mosses; but he suggested that I should publish the Suffolk list simultaneously, as it would be interesting to compare the two.

The first complete list of Suffolk Mosses is contained in Henslow and Skepper's Suffolk Flora, which, though concise, is, I think, good and reliable. In 1885 and 1888 I gave, in the 'Journal of Botany,' nearly all the information I could procure on the "Moss Flora of Suffolk." These two papers are here combined, and many new localities and a few new species added. I am fortunate in possessing very trustworthy materials for this enumeration. I have a good number of specimens from the late Mr. E. Skepper of Bury St. Edmund's, mostly collected by himself, while some were from Mr. F. K. Eagle, also of Bury, and others from Dr. White of Lavenham. I have besides these a good many specimens from the late Rev. W. M. Hind, LL.D., Rector of Honington, and Mr. W. Jordan of Cockfield, and a few gathered by myself in East and West Suffolk. All these were verified, and in many cases determined by Mr. H. Boswell of Oxford, the Referee of the Botanical Record Club, for whom the list was originally undertaken.

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Mr. H. N. Dixon published some additions to the Suffolk list in the 'Journal of Botany' for 1885 and 1886, and kindly sent me specimens of most of these additions. The Herbarium formed by Mr. E. Skepper was sent to the Rev. James Fergusson of Fern Brechin, who carefully examined it, and sent me copious notes on the specimens contained in it. Sir Charles Bunbury of Barton Hall, near Bury St. Edmund's, bequeathed his Herbarium to the University of Cambridge, and it is now in the Botanical Museum there; it contains many Suffolk Mosses collected by himself, while Mr. Eagle's collection of Mosses is also incorporated with it. Several of Mr. Eagle's specimens in this Herbarium have notes and drawings appended by Mr. Wilson, the author of 'Bryologia Brittanica,' while the names of a few others are corrected by him. The late Mrs. Skepper very kindly presented to the Cambridge Botanical Museum over twenty letters from Mr. Wilson to Mr. Eagle, in which is much information on specimens in Mr. Eagle's collection. I have therefore quoted from these letters. The late Dr. Hind very kindly sent me a list of all the SUFFOLK Mosses contained in Sir Charles' Herbarium with their localities, but it has not been examined by any specialist. Hence Mr. Eagle's and Sir C. Bunbury's species are given as named in the Herbarium. I have also quoted from the 'Old Botanists' Guide' (O. B. G.), from the 'Natural History of Yarmouth'; from Henslow and Skepper's 'Suffolk Flora,' &c.

The parishes of Tuddenham and Wangford mentioned in this list are the parishes of those names in West Suffolk, both lying in the sandy tract to the North-west of the County, usually known as the Breck District.

Mr. Skepper's and Dr. White's specimens were, I believe, mostly collected about the years 1858 to 1862; Mr. F. K. Eagle's and Sir Charles Bunbury's in the first half of the last century. The Western Division of the County has been fairly well searched; but the Eastern Division has only been examined, to any extent, near Yarmouth, by such good observers as Sir W. Hooker, and Messrs. Turner, Dickson, &c., early in the last century.

Several Herbaria, as, for instance, Mrs. Casborne's at Troston Hall, contain specimens of Suffolk Mosses, but as they have not been properly examined I do not generally quote them. The

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nomenclature employed in this list is that of the London Catalogue of British Mosses and Hepatics, 1881.

The Abbreviations are as follows :—

C. B. The late Sir C. Bunbury, Bart., of Barton Hall.
E. N. B. The Rev. E. N. Bloomfield, Guestling, Sussex.
H. N. D. Mr. H. N. Dixon, F.L.S., Northampton.
E. Mr. Eagle's specimens in Sir C. Bunbury's Herbarium,
Eagle. Specimens from Mr. Eagle, given me by Mr. Skepper.
Fl. 'Flora of Suffolk,' Henslow and Skepper, 1860.
W. M. H. The Rev. W. M. Hind, LL.D., Rector of Honington.
O. B. G. 'Old Botanists' Guide,' 1805 (Suffolk Records).
E. S. Specimens from Mr. Skepper.
Sk. MS. Notes by Mr. Skepper.
Sk. Herb. Mr. Skepper's Moss Herbarium. Specimens vouched for by the Rev. James Fergusson.
Hist. Yar. Sketch of the Natural History of Yarmouth, by C. J. and James Paget, 1834.

The numbers are those of the vice-counties, 25 being East Suffolk, which is separated from 26 West Suffolk, by the line of 1° East Longitude.

SPHAGNACEÆ.

SPHAGNUM ACUTIFOLIUM, Ehrh. Bogs, very common, Fl. 25. Dunwich. 26. Tuddenham.

„ „ var. DEFLEXUM, Schpr. 25. Dunwich, W. M. H. 26. Tuddenham, E. S.

„ „ var. PURPUREUM, Schpr. 26. Tuddenham, Sk. Herb.

„ FIMBRIATUM, Wils. 25. Somerleyton, Sk. Herb.

„ SQUARROSUM, Pers. 25. Belton Common, O. B. G. Somerleyton, Sk. Herb. Lound, H. N. D. 26. Redgrave Fen, W. M. H. Icklingham and Lackford, E. The figure in Engl. Bot. was taken from a Belton specimen.

„ INTERMEDIUM, Hoffm. 25. Belton, E. S. and W. M. H.

„ RIGIDUM, var. COMPACTUM, Brid. Suffolk, E. 26. Tuddenham. Sk. Herb.

„ SUBSECUNDUM, var. CONTORTUM, Schultz. 25. Dunwich, W. M. H. Lound, H. N. D.

„ „ var. OBESUM, Wils. 25. Dunwich, W. M. H.

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SPHAGNUM PAPILLOSUM, var. CONFERTUM, Lindb. 26. Tuddenham Sk. Herb.

„ CYMBIFOLIUM, Ehrh. 25. Dunwich, W. M. H. Lound, H. N. D. 26. Tuddenham, E. S.

„ „ var. SQUARRULOSUM, Nees. 25. Lound, H. N. D.

WEISSIACEÆ.

SYSTEGIUM CRISPUM, Hedw. 26. Barton, 1827, 1832, 1864, C. B.

GYMNOSTOMUM MICROSTOMUM, Hedw. 26. Tuddenham, Eagle. Bury, E. S.

[*Gymnostomum curvirostrum.* This was inserted in the Flora by mistake for *Weissia curvirostra, i.e., Didymodon rubellus*, B. and S.]

WEISSIA VIRIDULA, Brid. Very common. 25 and 26.

„ CIRRHATA, Hedw. Park palings, rails, &c. 25. Benacre, Henham, Little Glemham, &c. 26. Hengrave, March, 1827, C. B. and O. B. G.

DICRANELLA CRISPA, Hedw. 25. Herringfleet (Turner, 1809), Braithwaite and Hist. Yar.

„ CERVICULATA, Hedw. 25. Belton, E. S. and E. N. B. Gorleston, &c., not uncommon, Hist. Yar. 26. Wangford, 1825, E.

„ VARIA, Hedw. 25. Lily Pits Bradwell, O. B. G. 26. Bury, Mildenhall, &c. On chalk and in chalk pits, abundant, Sk. MS.

„ RUFESCENS, Turn. Suffolk, E.

„ HETEROMALLA, Hedw. Sandy shady banks, frequent. 25 and 26.

DICRANUM SCOPARIUM, L. Heaths and woods, common, Fl. 25 and 26.

„ PALUSTRE, Bry. Brit. 25. Benacre, Belton, &c., Sk. MS. Fritton, &c., Hist. Yar. 26. Tuddenham and Rougham, E. S. Lackford, E.

CAMPYLOPUS FLEXUOSUS, Brid. 25. Walberswick, H. N. D.

„ PARADOXUS, Wils. 25. Walberswick, H. N. D.

„ FRAGILIS, B. and S. 25. Lound, H. N. D. Slender form.

„ PYRIFORMIS, Brid. 25. Tunstall, E. N. B. Walberswick, H. N. D. Lowestoft and Herringfleet, Sk. MS. 26. Tuddenham, E.S.

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LEUCOBRYACEÆ.

LEUCOBRYUM GLAUCUM, L. Heaths, rather local. 25. Belton, Walberswick, Benacre, &c. 26. Tuddenham and Livermere.

BRUCHIACEÆ.

PLEURIDIUM NITIDUM, Hedw. 26. Brandon, E.

„ SUBULATUM, L. 25. Dry banks, common, Hist. Yar. 26. Rougham, Felsham, &c., E. S.

„ ALTERNIFOLIUM, B. and S. 26. Barton, Sk. Herb. Bury, E. S.

SELIGERIACEÆ.

SELIGERIA CALCAREA, Dicks, 26. Bury, Eagle. Barton Mills, C. B. Chalk pits about Bury, frequent, Fl.

POTTIACEÆ.

SPHÆRANGIUM MUTICUM, Schreb. 26. Risby, Eagle. Barton, November, 1885, C.B. Rougham and Bury, E.

PHASCUM CUSPIDATUM, Schreb. Banks and fields, frequent, Fl. 25. Bradwell, &c., Hist. Yar. 26. Bury, E. S. Barton, &c.

„ BRYOIDES, Dicks. 25. Great Glemham, on gravel paths, E. N. B. 26. Barton and Hardwick Heath, Eagle. Mildenhall, December, 1856, C.B.

„ RECTUM, Sm. 26. Newmarket, E. Perhaps not in Suffolk.

POTTIA CAVIFOLIA, Ehrh. Common on banks, Fl. 26. Bury, E. S. Wangford and Thetford, E.

„ MINUTULA, Schwg. 25. Near Bradwell Sun, Hist. Yar. 26. Bury, E. Lavenham and Cockfield.

„ TRUNCATA, L. Frequent in fields, &c. 25 and 26.

„ INTERMEDIA, Turn. 25. Bradwell, very common about Yarmouth, O. B. G. 26. Risby, Eagle. Rougham and Fornham, E.

„ HEIMII, Hedw. 25. Felixstow, W. M. H. River side near Yarmouth, O. B. G. Breydon Wall, Hist. Yar. 26. Wattisfield, E.

„ STARKEANA, Hedw. 25. Belton, Mr. Borrer. 26. Bury, C. B.

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POTTIA LANCEOLATA, Dicks. Frequent on banks, Fl. 26. Bury, E. S. and E. Barton, C. B.

„ CRINITA, Wils. 25. Southwold, H. N. D.

DIDYMODŌN RUBELLUS, B. and S. 25. Blythburgh, H. N. D. Clay-pit at Bradwell, 1816, Hist. Yar. 26. Bury, Eagle. Rushbrook, Wangford, and Mildenhall, E. Between Rougham and Bury, C. B.

„ LURIDUS, Hornsch. 25. Dunwich on stones, H. N. D.

DITRICHUM FLEXICAULE, Schwg. 26. Risby Heath, E. S. Thetford Warren, Eagle. Mildenhall, C. B.

TRICHOSTOMUM TOPHACEUM, Brid. 26. Wangford and Eriswell, E.

BARBULA RIGIDA, Schulz. 26. Barton, C. B. Thetford (*enervis*), E. Of Mr. Eagle's specimens, Mr. Wilson writes, "The leaves are particularly broad and obtuse."

„ ALOIDES, Koch. 25. Great Glemham, E. N. B. Burgh Castle, Hist. Yar. 26. Bury and Barton, E. S. Bury E.

„ LAMELLATA, Lindb. 26. Bury, Eagle and E.

„ CUNEIFOLIA, Turn. 25. Hopton on a sandy bank, O. B. G. Belton Common, Fl.

„ MARGINATA, B. and S. 25. Blythburgh Church on stones, H. N. D.

„ MURALIS, L. Very common on walls, &c. 25 and 26.

„ „ var. ÆSTIVA, Brid. Woodbridge, E.

„ UNGUICULATA, Dill. Very common. 25 and 26.

„ „ var. APICULATA, Hedw. Suffolk, E.

„ FALLAX, Hedw. Common. 25 and 26.

„ RIGIDULA, Dicks. 26. Wangford, E.

„ CYLINDRICA, Tayl. 25. Great Glemham, E. N. B.

„ VINEALIS, Brid. 26. Road to Whepstead, Bury, E. Mr. Eagle speaks of this as common, and Mr. Wilson rejoins, "As common with us in a barren state as with you."

„ REVOLUTA, Schwg. 25. Great Glemham, E. N. B. 26. Bury, Eagle. Barton, C. B. Mildenhall, E.

„ CONVOLUTA, Hedw. 26. Thurston, E. S. Wangford and Rougham, E.

„ SUBULATA, L. Common on shady banks, Fl. 25. Swefling, E. N. B. Very common, Hist. Yar. 26. Bury, Barton, &c.

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BARBULA LÆVIPILA, Brid. Probably common. 25. Rendham and Great Glemham, E. N. B. 26. Lavenham and Bury, E. S.

„ RURALIS, L. Common on roofs, &c. 25. Great Glemham. 26. Honington, &c. Also common on sandy heaths. 25. Aldeburgh, Orford. 26. Wangford, Thetford, &c. This is probably Braithwaite's variety, *arenicola*.

„ LATIFOLIA, B. and S. 25. Halesworth and Mendham, E. 26. Groton. E. Mr. Eagle sent many fruiting and other specimens to Mr. Wilson. Both of them failed to detect any male inflorescence. It is very rare in fruit.

„ INTERMEDIA, Brid. 25. Blythburgh, H. N. D. 26. Cockfield, W. Jordan.

„ PAPILLOSA, Wils. 25. Wrentham, H. N. D. Halesworth and Mendham, E. 26. Groton, Bury near Mermaid Pits, E.

CERATODON PURPUREUS, L. Very common. 25 and 26.

ENCALYPTA VULGARIS, Hedw. 25. Bradwell and Burgh Castle walls, Hist. Yar. Bungay Castle walls, Mr. Stone. 26. Horringer, Barton, &c.

GRIMMIA APOCARPA, L. 25. Benhall on tomb, E. N. B. Walls and roofs, Bungay, Mr. Stone. 26. Bury, E. S. and E. Barton, C. B.

„ PULVINATA, Dill. Abundant on walls and roofs. 25 and 26.

RHACOMITRIUM CANESCENS, Hedw. Heaths not uncommon. 25. Lowestoft Denes, Tunstall, &c. 26. Tuddenham, Santon Downham, and Thetford.

[*R. lanuginosum*. This was entered in the Suffolk Flora by mistake for *R. canescens*.]

RHACOMITRIUM CANESCENS, var. ERICOIDES, Bry. Eur. Suffolk, E.

ZYGODON VIRIDISSIMUS, Dicks. 25. Walberswick Church on stones, Wrentham, H. N. D. Very common on trees about Yarmouth, O. B. G. 26. Hardwick, E. S. Rougham and Bury, E.

ULOTA CRISPA, Hedw. 25. Near Bungay, Mr. Stone. Not uncommon, Hist. Yar. 26. Felsham Wood, Sk. Herb. Redgrave Park and Mildenhall, E.

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ULOTA INTERMEDIA, Schpr. 25. Framlingham, Eagle.

„ PHYLLANTHA, Brid. Mr. Wilson received a specimen from Suffolk. 26. West Stow, E. N. B.

ORTHOTRICHUM SAXATILE, Brid. 25. Burgh Castle walls, H. N. D. 26. Thurston, E. Stowlangtoft, Icklingham, both churches, E. S.

„ CUPULATUM, Hoffm. 25. Swefling, by side of river on foot of an Ash, E. N. B.

„ AFFINE, Schrad. Common on pales, trees, &c., 25 and 26.

„ TENELLUM, Bruch. 26. Bury by Mermaid Pits, E. Mr. Wilson writes, "I believe it to be *O. tenellum*, the yellow calyptra seems to be peculiar to this species."

„ DIAPHANUM, Schrad. Not uncommon 25. Great Glemham, &c. 26. Risby, Bury, &c.

„ LYELLII, H. and T. Not uncommon. 25. Great Glemham, E. N. B. Framlingham, E. 26. Hardwick and West Stow, E. S. Bury, E.

[*O. pulchellum.* Recorded in error from Burgh Castle, Braithwaite, Brit. Moss Flora.]

ORTHOTRICHUM LEIOCARPUM, B. and S. Somewhat rare in Suffolk. 25. Rendham, E. N. B. Framlingham, E. 26. Lavenham, E. S. Mildenhall, C. B. Pakenham, Mrs. Casborne.

SPLACHNACEÆ.

SPLACHNUM AMPULLACEUM, L. 25. Belton bog, O. B. G. 26. Tuddenham, 1842, Eagle. Lakenheath, 1807, E. Wangford, Fl.

FUNARIACEÆ.

EPHEMERUM SERRATUM, Schreb. 25. Bradwell, O. B. G. 26. Barton, 1825 and 1832, C. B. Bury, Fl.

PHYSCOMITRELLA PATENS, Hedw. 26. Wangford, E.

PHYSCOMITRIUM PYRIFORME, L. Not uncommon. 25. Great Glemham, E. N. B. Belton, &c., common, Hist. Yar. 26. Cockfield, Tuddenham, &c.

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FUNARIA FASCICULARIS, Dicks. 25. Belton Common (D. T.), Hist. Yar. 26. Lavenham, Dr. White. Rougham and Tuddenham, E. Barton, C. B.

,, HYGROMETRICA, L. Very common. 25 and 26.

BARTRAMIACEÆ.

AMBLYODON DEALBATUS, Dicks. 26. Tuddenham, E. Specimens were sent by Mr. Eagle to Mr. Wilson, and were confirmed by him.

BARTRAMIA POMIFORMIS, L. Scarce. 25. Henham, Eagle. Lound, H. N. D. Blundeston, Hist. Yar. 26. Woolpit, Mrs. French. Brandon, Sk. Herb. Santon Downham, &c.

PHILONOTIS FONTANA, L. 25. Somerleyton, E. S. Bungay and Belton. 26. Tuddenham, Lakenheath, &c.

,, CALCAREA, B. and S. 26. Tuddenham, Sk. Herb.

BRYACEÆ.

LEPTOBRYUM PYRIFORME, L. 26. Wangford, and Barton Mills, E. On pots in greenhouses, Great Glemham and Barton.

WEBERA NUTANS, Schreb. 25. Belton Common and Ashby Warren, Hist. Yar. 26. Santon Downham, Sk. Herb. Tuddenham, E. Cavenham Severals, Sk. M.S.

,, ELONGATA, Dicks. 26. Santon Downham, Sk. Herb.

,, CARNEA, L. Not rare. 25. Belton, E. N. B. Bradwell, Hist. Yar. 26. Bury, E. S. Tuddenham, Woolpit, &c.

BRYUM PENDULUM, Hornsch. 26. Thetford Warren, W. M. H.

,, INCLINATUM, Swartz. Felixstow, W. M. H.

,, LACUSTRE, Brid. 25. Gorleston, marsh adjoining turnpike gate, O. B. G. 26. Wangford, 1804, E. One of the specimens from Wangford has a double capsule. Mr. Wilson says, "I never before met with a similar instance, except that I have seen two capsules on the same receptacle in *Sphagnum contortum*, and a forked seta of a species of *Bryum*—of this I enclose a sketch."—The specimen and sketch are in Sir C. Bunbury's Herbarium.

[I have met with forked setæ of *Bryum hornum*, but only one fork bore a capsule.—E. N. B.]

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BRYUM INTERMEDIUM, W. and M. 26. Lavenham, Dr. White. Mildenhall, E. Determined by Mr. Wilson, and there is in the Herbarium a drawing of the capsule by him.

„ BIMUM, Schreb. 26. Lavenham, Dr. White. Lakenheath, Sk. Herb. Brandon, 1807; Lackford, E.

„ ATROPURPUREUM, W. and M. 25. Great Glemham, E. N. B. Felixstow, W. M. H. Southwold, H. N. D. 26. Bury, Sk. Herb. Wangford, E.

„ CAESPITITIUM, L. Common. 25 and 26.

„ ARGENTEUM, L. Common on walls, &c. 25 and 26.

„ CAPILLARE, L. Very common on banks, &c. 25 and 26.

„ DONIANUM, Grev. 26. Ixworth Thorpe, W. M. H. Not in fruit, hence perhaps doubtful.

„ PALLENS, Swartz. 26. Tuddenham, E. S.

„ PSEUDO-TRIQUETRUM, Hedw. 26. Cavenham Severals, E. S. Thetford Warren, Redgrave Fen, and Hinderclay Fen, W. M. H.

[*Bryum turbinatum.* The Moss so called in the Flora is that of Hooker, which includes several species. The specimens so named are *B. pallens* and *B. bimum.*]

BRYUM ROSEUM, Schreb. Suffolk, E. 25. Near Bungay, Mr. Stone. 26. Rougham Heath, Sk. MS.

MNIACEÆ.

CINCLIDIUM STYGIUM, Swartz. 26. In a bog at Tuddenham. Abundantly in fruit, November, 1860, and November, 1862, E. S. and E. N. B.

MNIUM CUSPIDATUM, Hedw. 25. Fritton, H. N. D. 26. Lakenheath and Lackford, E. S. Barton, C. B. Westley, c. fr., Sk. MS. Common, but rare in fruit.

„ AFFINE, Bland. 26. Fornham St. Martin, April, 1856, c. fr., E. S. Mildenhall, c. fr. and Rougham, E.

„ UNDULATUM, Hedw. Common, but scarce in fruit. 25. Great Glemham and Benhall, c. fr., E. N. B. 26. Barton, c. fr., Fl.

„ ROSTRATUM, Schreb. 25. Great Glemham, c. fr., E. N. B. 26. Ixworth Thorpe, W. M. H. Lavenham Gill, Sk. MS.

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MNIUM HORNUM, L. Not very common. 25. Great Glemham, Fritton Decoy, &c. 26. Felsham Wood, Mildenhall, &c.

,, SERRATUM, Schrad. 26. Ixworth Park, W. M. H.

,, PUNCTATUM, Hedw. 25. Belton bog, rare, Hist. Yar. 26. Wiston and Nayland, W. M. H.

,, SUBGLOBOSUM, B. and S. 26. Tuddenham, Sk. Herb.

AULACOMNIUM ANDROGYNUM, L. Suffolk, E. 25. Ipswich, E. Belton bog, rare, Hist. Yar.

,, PALUSTRE, L. 25. Lowestoft, Walberswick, &c. 26. Tuddenham, c. fr., Lackford, &c. Probably wherever there are bogs, but these are scarce in Suffolk.

,, ,, var. IMBRICATUM. 26. Tuddenham, Sk. Herb.

,, ,, var. RAMOSUM. Suffolk, E.

POLYTRICHACEÆ.

ATRICUM UNDULATUM, L. Very common. 25 and 26.

POGONATUM NANUM, Neck. 25. Bungay, Fritton, &c. 26. Tuddenham, Barton, Rougham.

,, ALOIDES, Hedw. Common. 25 and 26.

,, ,, var. MINUS (Dicksoni). 25. Sandy banks about Hopton and Lound, O. B. G. Hopton (Turner, 1802), Braithwaite. Lound and Fritton, Hist. Yar.

,, URNIGERUM, L. 26. Sandy bank near Lackford, 1825, C. B.

POLYTRICHUM FORMOSUM, Hedw. 26. Felsham Wood, E. S.

,, GRACILE, Menz. 26. Cavenham Severals, E. S. Hinderclay Fen, W. M. H.

,, PILIFERUM, Schreb. 25. Great Glemham, E. N. B. 26. Thurston, Tuddenham, &c. Heaths, common, Fl.

,, JUNIPERINUM, Willd. Heaths and sandy soil, common. 25 and 26.

,, STRICTUM, Banks. 25. Herringfleet (Turner, 1806), Braithwaite.

,, COMMUNE, L. Heaths, &c., common. 25 and 26.

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FISSIDENTACEÆ.

FISSIDENS BRYOIDES, Hedw. 25. Woodbridge, E. 26. Barton, C. B. Felsham Wood, W. Jordan.

„ INCURVUS, W. and M. 26. Bury, E. S.

„ ADIANTOIDES, Hedw. 25. Walberswick, H. N. D. Belton bog, Hist. Yar. 26. Tuddenham, E. S. Brandon, 1825, C. B.

„ TAXIFOLIUS, L. 25. Rendham. 26. Barton. Doubtless common.

RIPARIACEÆ.

FONTINALIS ANTIPYRETICA, L. 25. Great Glemham and Saxmundham, E. N. B. 26. Troston, c. fr., Eagle. Lavenham, Barton, Brandon, &c.

CRYPHÆACEÆ.

CRYPHÆA HETEROMALLA, Hedw. 25. Trees about Yarmouth, common, O. B. G. 26. Barton, 1825, 1832, 1869, C. B. Barton Mills, Sk. MS.

LEUCODONTACEÆ.

LEUCODON SCIUROIDES, L. Common on trees, Fl. 25. Great Glemham, Bungay, &c. Burgh Castle walls, Hist. Yar. 26. Barton, Honington, &c.

ANTITRICHIA CURTIPENDULA, L. Rare. 25. Lowestoft Denes, E. S. Framlingham near Countess Well, growing luxuriantly on a tree, E. Herringfleet Decoy, on thatch of boat-house, Fl.

NECKERACEÆ.

NECKERA COMPLANATA, L. Common, but rare in fruit. 25. Benhall, c. fr., E. N. B. 26. Barton, c. fr., C. B.

HOMALIA TRICHOMANOIDES, Schreb. Not uncommon. 25. Benhall, c. fr. 26. Felsham Wood and Hardwick, c. fr., E.S.

LESKEACEÆ.

LESKEA POLYCARPA, Ehrh. 25. Swefling, at roots of Ash by riverside, E. N. B. Westleton, on trunks of trees, Fl.

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ANOMODON VITICULOSUS, L. Frequent on trees near the ground, Fl. 25. Benhall, c. fr., E. N. B. 26. Cockfield, c. fr., W. Jordan. Lavenham, c. fr., E. S.

THUIDIUM TAMARISCINUM, Hedw. Very common. 25 and 26. Felsham Wood, c. fr., E. S. Euston, c. fr., E.

„ HYSTRICOSUM, Mitt. 26. Barton Mills (Borrer), Braithwaite.

„ ABIETINUM, L. 26. Not uncommon in the N. W. of the County, as Bury, Thetford, Icklingham, &c.

HYPNACEÆ.

THAMNIUM ALOPECURUM, L. Common on shady banks. 25 and 26.

CLIMACIUM DENDROIDES, L. 25. Near Orford Castle, E. N. B. 26. Tuddenham and Cavenham Severals, c. fr., E. S. Common in the N.W. of the County.

ISOTHECIUM MYURUM, Poll. Frequent. 25. Framlingham, E. 26. Bury, Rushbrook, &c.

HOMALIUM SERICEUM, Schpr. Common on trees. 25 and 26.

CAMPTOTHECIUM LUTESCENS, Huds. Very common on the light lands, but rare in fruit. 25. Bradwell, from which the fruiting specimen was figured in Engl. Bot. 26. Bury, c. fr., E.S. Barton and Mildenhall, c. fr., C.B.

„ NITENS, Schreb. Suffolk, E. 26. Lackford bog, 1840, C.B.

SCLEROPODIUM? ILLECEBRUM, Schwg. (BLANDUM). 26. Between Rougham and Bury, C. B. Thetford, E.

BRACHYTHECIUM GLAREOSUM, B. and S. 25. Orford, E. N. B. Walton, W. M. H.

„ ALBICANS, Neck. Sandy and heathy ground, rare in fruit. 25. The figure in Eng. Bot. was taken from a fruiting specimen gathered at Gorleston; Fritton, &c. 26. Barton Mills, Barton, &c.

„ VELUTINUM, L. Abundant. 25. Martlesham, &c. 26. Mildenhall, Barton, &c.

„ RUTABULUM, L. Very common. 25 and 26.

„ RIVULARE, B. and S. 26. Barton and Santon Downham, Sk. Herb.

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EURRHYNCHIUM MYOSUROIDES, L. 25. Bungay, Mr. Stone.
" STRIATUM, Schreb. Common. 25 and 26.
" PILIFERUM, Schreb. 25. Great Glemham, E. N. B. Bradwell, &c., Hist. Yar. 26. Hardwick, E. S. Honington, W. M. H. Barton, C. B.
" SWARTZII, Turn. 26. Lakenheath, E. Barton Mills, c. fr., C. B. Troston, &c., Sk. MS.
" PRÆLONGUM, Dill. Very common. 25 and 26.
" PUMILUM, Wils. 25. Lound, on a sandy bank, H. N. D.

RHYNCOSTEGIUM TENELLUM, Dicks. 25. Eye Churchyard, c. fr., E. Framlingham Castle, Fl. Burgh Castle wall, Hist. Yar.
" CONFERTUM, Dicks. Probably common. 25. Swefling, E. N. B. Common, Hist. Yar. 26. Honington, Barton, Mildenhall, &c.
" MURALE, Hedw. Walls at Herringfleet Hall, O.B.G. 26. Bury and Risby Chuach, E. Horringer Church, and Lavenham, Sk. MS.
" RUSCIFOLIUM, Neck. Common. 25 and 26.

PLAGIOTHECIUM LATEBRICOLA, Wils. 25. Belton, Sk. MS.
" DENTICULATUM, L. Not uncommon. 25. Great Glemham and Swefling, E. N. B. Belton, &c., Hist. Yar. 26. Felsham, Redgrave, &c.
" SYLVATICUM, L. 26. Barton, November, 1831, C. B.
" UNDULATUM, L. Rare. 25. Wood near Fritton Broad, H. N. D. 26. Felsham Wood, E. S. Lakenheath, E.

AMBLYSTEGIUM SERPENS, L. Common. 25 and 26.
" RADICALE, P. Beauv. 25. Icklingham Sluice, c. fr., E. Both barren and fertile specimens were sent to Mr. Wilson.
" RIPARIUM, L. 25. Fritton Decoy, Sk. Herb. Southwold and Walberswick, H. N. D. 26. Bury, &c., Sk. MS.

HYPNUM ADUNCUM, Hedw. 26. Barton Mere, E. S.
" " var. KNEIFFII, Bry. Eur. 25. Benhall in brick pit, E. N. B. 26. Knettishall, W. M. H.
" EXANNULATUM, Gümb. 26. Tuddenham, E. S.

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HYPNUM COSSONI, Schpr. 26. Tuddenham, E. S. Redgrave Fen, E. M. Holmes.

„ SENDTNERI, var. HAMATUM, Lindb. Tuddenham, Sk. Herb.

„ FLUITANS, L. 25. Lowestoft, E. N. B. 26. Tuddenham, E. S. Redgrave Fen, Fakenham and Market Weston, W. M. H.

„ UNCINATUM, Hedw. 25. Belton, Hist. Yar. 26. Wangford, 1825, c. fr., E.

„ FILICINUM, L. 25. Benhall in brick pit, E. N. B. Belton, Hist. Yar. Bungay, Mr. Stone. 26. Tuddenham, E. S. Honington, W. M. H. Lakenheath, Sk. MS.

„ COMMUTATUM, Hedw. 25. Lowestoft, Sk. MS. 26. Tuddenham, E.S. Hopton Fen, Hinderclay, Redgrave, W. M. H.

„ FALCATUM, Brid. 25. Gorleston, Sk. Herb. 26. Tuddenham, Dr. White.

„ RUGOSUM, Ehrh. 26. Heathy places in the Breck district; Icklingham, Lakenheath, Santon Downham, &c.

„ CUPRESSIFORME, L. Very variable and abundant. 25 and 26.

„ „ var. TECTORUM, Schpr. 26. Rougham, Sk. Herb.

„ „ var. FILIFORME, Bry. Eur. 26. Lavenham.

„ „ var. ERICETORUM, Bry. Eur. 25. Lound Turn, Herb. 26. Tuddenham, Sk. Herb, Mildenhall, E.

„ „ var. LACUNOSUM, Hoffm. Rougham, Sk. Herb.

„ RESUPINATUM, Wils. 26. Cockfield, W. Jordan, Lavenham.

„ MOLLUSCUM, Hedw. 25. Bungay, Mr. Stone. 26. Tuddenham, c. fr., E. S. Mildenhall, c. fr., and Barton, C. B. Redgrave, &c.

„ PALUSTRE, L. 25. Belton bog, very rare, Hist. Yar. 26. Barton Mills, c. fr., and Priory, Bury, E.

„ ELODES, Spruce. 26. Redgrave Fen, E. M. Holmes.

„ POLYGAMUM, B. and S. 26. Tuddenham, c. fr., Sk. Herb. Lakenheath, c. fr., E.

„ „ var. STAGNATUM, Wilson, MS. Lakenheath, c. fr., E. These were determined by Mr. Wilson.

„ STELLATUM, Schreb. 25. Belton bog, Hist. Yar. 26. Tuddenham, c. fr., E. S. Mildenhall, c. fr., and Lackford, C. B. Redgrave Fen, &c.

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HYPNUM CORDIFOLIUM, Hedw. 25. Bogs on Bradwell and Belton Commons, O. B. G. 26. Tuddenham, E. N. B. Mildenhall, c. fr., C. B. Santon Downham, c. fr. (Eagle), Sk. Herb.

„ GIGANTEUM, Schpr. 26. Tuddenham, E. S. Coney Weston and Redgrave Fen, W. M. H. Mildenhall, 1827, c. fr., and Brandon, c. fr., E.

„ CUSPIDATUM, L. Common. 25 and 26. c. fr., Woolpit and Barton.

„ SCHREBERI, Ehrh. Frequent on heaths. 25 and 26. Mildenhall, c. fr., C. B.

„ PURUM, L. Very common. 25 and 26. c. fr., Hardwick, Felsham Wood, &c.

„ STRAMINEUM, Dicks. 25. Bogs at Belton near Browston Hall, O. B. G. Suffolk (Turner), C. B. This was probably from Belton.

„ SCORPIOIDES, L. 25. Belton bog, &c., Hist. Yar. 26 Tuddenham and Lakenheath, E. S. Redgrave Fen, W. M. H. and E. M. Holmes. Mildenhall, c. fr., 1827, C. B. Icklingham, E.

HYLACOMIUM SPLENDENS, Dill. Somewhat common. 25 and 26. Tuddenham, c. fr., E. S. Mildenhall, c. fr., C. B. beautiful specimens with many capsules.

„ SQUARROSUM, L. Very common. 25 and 26, c. fr., Tuddenham and Pakenham.

„ TRIQUETRUM, L. Common. 25 and 26, c. fr., Felsham Wood, Hawstead, Barton and Thetford.

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XV.

OBSERVATIONS ON THE VIPER (*PELIUS BERUS*).

By Rev. M. C. H. Bird, M.A., M.B.O.U.

Read 26th February, 1901.

In Gilbert White's 'Natural History of Selborne' (in the Naturalist's Calendar), October 28th is given as the latest date on which Vipers were observed abroad by Markwick. The first part of November, 1890, was not exceptionally mild, but on the 5th a Viper was seen out at Stalham, and on November 10th I had one brought to me from the same neighbourhood; it was a female, and measured 25 inches in length, gape $\frac{1}{2}$ an inch, extending to $1\frac{1}{8}$ inch. It contained 23 eggs, which measured from $\frac{1}{8}$ to $\frac{5}{8}$ inch in length. It was very fat. The stomach was empty, and I injected one-third of a pint of water, and then, perhaps, did not test its greatest capacity. (In the 'Zoologist' for 1900, p. 395, Dr. Leighton gives the average length of the gullet in Vipers as 9 inches; and the average diameter, when distended, 1 inch, the average circumference $3\frac{1}{2}$ inches.) In June, 1891, I asked Money, gamekeeper at Blickling Hall, whether he had ever seen a Viper swallow her young. He replied, "Yes, and I once saw two young Thrushes fly down a Viper's throat," this in allusion to the old idea of animal magnetism being employed by Snakes, Foxes, and Stoats.

On August 30th, 1892, I had a female Viper brought to me from East Ruston, which was supposed to have been "caught in the very act," &c. Taking it down to the late Dr. Walker's surgery at Stalham, with his assistance, I filled its throat and stomach with plaster of Paris, and the following day we held a *post-mortem*, the verdict being, that the Viper had probably been killed whilst in the act of parturition, she having, when we opened her, seven young ones inside her, but all of them *outside* the abdominal coat; they

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were all of a uniform size, the one I measured being $5\frac{3}{8}$ inches in length and $\frac{5}{8}$ inch in circumference. Each Viperling was contained in a thin transparent membrane. The diagonal back stripe was very distinct, and the poison fangs fully developed.

On July 8th, 1897, I came across the only Red Viper it has ever been my lot to see; it was hanging up outside Mr. A. Nichols' shop at Stalham, and was killed "up the river" by himself and a friend. Between July 25th and 28th, 1898, Mr. Nichols and his nephew killed two Vipers on the edge of Barton Broad, one measuring 25 inches, the other 23; the latter was a "red" one. In Kent, Red Vipers are rare, but are looked upon as the most venomous (F. Roberts). Alfred Nudd, marshman of Hickling, who for the last twenty years or more has been in at the death of some dozen Vipers per annum at least, last year killed over a score, and seventeen in 1897. I have no account of the exact number of Vipers killed by Nudd in other seasons, but the above-mentioned average is none too large. He only remembers having seen one red one, and that was "several years ago." I was at Hickling on May 5th, 1898, and Nudd told me that a few days previously he was walking along the wall round the Broad with Harvey the gamekeeper, when they saw a Viper take three eggs out of a Thrush's nest, and Harvey shot the reptile as it was in the act of mouthing the fourth and last egg. I can remember when Vipers used to be hunted for, in the early seventies, at Winterton, for their oil. The last individual that hereabouts, so far as I am aware, has thus been made into "extract," was on April 15th, 1899. That clever old fisherman, noted local Snipe-snarer and Dog-breaker, Sam Harmer, alias Captain Hanks of Hickling, then boiled down a gravid female, which had, previously to his opening her, contained eight embryos. Under date July 10th, 1899, I have a note of a Viperling, eight inches in length, being killed on the sand-hills at Hempstead; and on August 22nd of the same year my diary makes mention of Mr. J. Waterson of East Ruston telling me that two or three years ago a neighbour's cat brought home a live Viper, and played with it on the cottage brick floor for some time before the goodman (Wiley) killed it. The cat seized the Viper carefully and cleverly at the back of the neck each time it pounced upon it, and received no harm.

My father-in-law, who used to live at East Rudham, lost several

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Sheep in former years from Viper bites, the many heaths and commons of West Norfolk abounding in these reptiles. As with all animals in a wild state, Vipers have their favourite localities; certain spots on sand-hills, marsh wall, or hedgerow bank, being a sure find in early Spring. Our marshes are much infested with Voles, the grass around the roots of Rush and Sedge being, in the drier spots, honey-combed with their runs. The abundance of these little rodents, and of Frogs too, perhaps accounts for the prevalence of Vipers and Short-eared Owls; and the few Harriers, that still annually visit us, may likewise be partly attracted by both reptiles and rodents. The Ring Snake I have never seen in East Norfolk, but Lizards are fairly common upon the dry marshes adjoining the sand-hills at Horsey. I saw more than a dozen there on May 13th, 1899.

The greatest number of eggs I have noted as taken from a Viper was 25, by Nudd, on May 9th, 1900. He killed nine adults that day. As to the swallowing trick, Dr. Leighton proved, in the 'Zoologist' for September, 1900, that "theoretically considered there is no anatomical reason why the theory should not be true." It does really seem impossible, when one reads all the many letters that have from time to time appeared in the sporting papers and other periodicals, within the past ten years, to believe that all the "eye-witnesses" who therein gave their impressions were deceived. But still, at the same time, the case must go as "unproven," for, in spite of the £10 reward offered in Yorkshire and Dumfries-shire by the late Sir W. H. Flower, and many other minor public offers made in other counties, no Viper with swallowed young inside it has ever been sent in on claim. Brusher Mills of the New Forest (who has caught as many as 3186 Vipers in fourteen years) wrote in February, 1895, offering to show the performance to any one who cared to visit him in the following July and August. Mr. Tegetmeier, Natural History Editor of 'The Field,' went down fruitlessly that year, and left Mills all the necessaries for forwarding samples to 'The Field' Office, but up to February, 1901, as Mr. Tegetmeier very kindly wrote me word, Mills has sent nothing more than two parturient females.

In vol. xiii. page 108 of the 'Boy's Own Paper,' Dr. Arthur Stradling, a well-known authority on reptiles, wrote, "I have never known any snake show the slightest care for its young."

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XVI.

ON MR. MARSHAM'S "INDICATIONS OF SPRING."

By Thomas Southwell, F.Z.S., V.-P.

Read 26th February, 1901.

In January, 1875, I communicated to our Society a table of the "Indications of Spring," compiled from the remarkable series of observations made by the Marsham family at and near Stratton Strawless, about seven miles north of Norwich, which the late Rev. H. P. Marsham had kindly placed in my hands for that purpose. This table which, with some introductory matter was printed in the second volume of our 'Transactions,' pp. 31—45, was brought down to the year 1874, and as Major H. S. Marsham, son of the above, has continued to register the "Indications," it struck me that the end of the century might be an appropriate time to give a complete summary of the whole series, ending with the year 1900; this, with the permission of Major Marsham, I now have much pleasure in doing, and I venture to think that the record embodying from 60 to 127 separate observations of each phenomenon, all made in the same locality, is altogether unprecedented.

In my former communication I gave some account of the origin of these observations which were begun in 1736 by Robert Marsham, F.R.S. (the correspondent of Gilbert White); they were rather irregularly kept till the year 1745, but from that time were made with great regularity (with one interval of 26 years between 1811 and 1835 both inclusive) by successive members of the Marsham family, to the present time. I also gave extracts from the interesting "Journal" in which Robert Marsham recorded observations on

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the weather and its influence on vegetation, also various natural phenomena as well as other circumstances which interested the writer of the "Journal," and without which the recorded "Indications" lose much of their significance; for these I must refer you to my original paper, and confine myself on the present occasion to endeavouring to explain, as far as possible, the meteorological conditions under which the earliest and latest extremes of the observations recorded since the year 1874 occurred. See Table I.

In looking at the records of these typical years it will be noticed how very irregular the relative succession of the occurrences in any given year frequently is; certain phenomena in the months of January and February may be very early, but those happening later in the same year may be deferred till long past their normal date, or *vice versâ;* such irregularities are of course entirely due to varying weather, all may be going on well, when a sudden spell of bad weather puts a temporary stop to further progress; this was notably the case in 1883; the winter was mild until March, and vegetation started unusually early, but with the advent of that month the weather assumed a most winterly type, and throughout the month there was no possibility of any advance being made. It will be seen that the Sycamore showed leaf very early in that year (the 25th of February), but I suspect that it was a prematurely early development, and had it been delayed a few days it would have been so checked by the sudden change that it would have made no further progress till more genial weather set in considerably later; in fact the leafing of the Sycamore, one of our earliest trees, as observed by Mr. Preston that year, did not take place till April 16th. On the other hand a sudden burst of warmth and sunshine may result in inducing a degree of progress which is truly amazing, thus suddenly restoring the balance or even converting what had hitherto been a backward season into an early one. The weather of January and February seems to have very little permanent influence on subsequent vegetation; nature is waiting expectantly, and should genial weather follow, the various later phenomena will appear in due course notwithstanding the severity of the earlier months.

It will thus be seen that without a key to their interpretation these observations may lose much of their significance, or even be misleading, and fortunately such a key has been supplied by the

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EXTRACT FROM THE REGISTER FOR THE YEARS MENTIONED IN THE FOREGOING NOTES.

N.B.—The dates printed in Italics are the extremes.

Indication.	1881.	1882.	1883.	1884.	1892.	1893.	1894.	1898.	1899.	Mean date and No. of observations.
		1881.	1882.				1893.			
SNOWDROP FLOWERS ...	Jan. 7	Dec. 16	Dec. 27	Jan. 16	Jan. 20	Jan. 26	Dec. 21	Jan. 9	Jan. 10	Jan. 15. 119
THRUSH SINGS	—	Jan. 1	—	—	*Mch. 20*	Jan. 4	Jan. 23	Jan. 12	Jan. 8	Jan. 27. 105
HAWTHORN LEAFS	Mch. 20	Feb. 23	Mch. 4	Feb. 17	Apl. 2	Mch. 18	Mch. 2	Mch. 14	Mch. 31	Mch. 10. 116
HAWTHORN FLOWERS ...	May 8	May 3	—	May 11	—	Apl. 22	Apl. 26	May 25	—	May 10. 112
FROGS AND TOADS CROAK ...	Mch. 11	Mch. 1	Apl. 7	Mch. 7	—	Mch. 26	*Feb. 22*	Mch. 26	Apl. 2	Mch. 22. 121
SYCAMORE LEAFS	Apl. 10	Mch. 23	*Feb. 25*	Mch. 16	—	Mch. 21	Apl. 2	Apl. 10	Apl. 23	Apl. 3. 108
BIRCH LEAFS	Apl. 13	Mch. 18	Apl. 7	Mch. 22	Apl. 20	Mch. 30	Apl. 6	Mch. 30	Apl. 20	Apl. 3. 115
ELM LEAFS	Apl. 28	—	—	Mch. 23	Apl. 29	Mch. 25	Apl. 12	May 4	*May 17*	Mch. 30. 92
MOUNTAIN ASH LEAFS ...	Apl. 13	Mch. 25	Apl. 7	Mch. 23	—	Mch. 27	Apl. 6	Apl. 12	Apl. 8	Apl. 8. 102
OAK LEAFS	Apl. 26	*Mch. 30*	Apl. 25	Apl. 9	Apl. 24	Apl. 4	Apl. 10	Apl. 16	Apl. 27	Apl. 24. 114
BEECH LEAFS	Apl. 28	Apl. 6	Apl. 26	Apl. 19	May 2	*Apl. 2*	Apl. 4	Apl. 18	May 3	Apl. 22. 117
HORSE-CHESTNUT LEAFS ...	Apl. 11	Mch. 20	Apl. 6	Mch. 25	Apl. 17	Mch. 16	Apl. 1	Apl. 4	Apl. 7	Apl. 3. 104
CHESTNUT LEAFS	Apl. 13	*Mch. 15*	Apl. 13	Mch. 23	May 3	Apl. 26	Apl. 17	Apl. 12	May 6	Apl. 20. 96
HORNBEAM LEAFS	Apl. 30	Mch. 27	—	Apl. 2	—	Apl. 10	Apl. 2	Apl. 2	Apl. 8	Apl. 5. 97
ASH LEAFS	—	—	May 9	Apl. 25	—	Apl. 10	Apl. 13	May 2	May 7	Apl. 29. 93
RINGDOVE COOS	—	—	—	—	—	Jan. 26	Mar. 1	Jan. 25	Jan. 13	Feb. 23. 90
ROOKS BUILD	Feb. 25	Feb. 27	Feb. 21	Feb. 20	Mch. 8	Jan. 25	Feb. 20	Feb. 28	Feb. 27	Feb. 27. 119
YOUNG ROOKS	Apl. 13	Apl. 7	Apl. 17	Apl. 13	Mch. 31	Apl. 5	Apl. 8	Apl. 18	Apl. 7	Apl. 10. 118
SWALLOWS APPEAR	*May 2*	Apl. 17	Apl. 26	Apl. 21	Apl. 12	Apl. 15	Apl. 16	*May 2*	Apl. 30	Apl. 18. 118
CUCKOO SINGS	Apl. 30	Apl. 28	Apl. 15	*Apl. 12*	Apl. 26	Apl. 18	Apl. 15	Apl. 23	Apl. 28	Apl. 24. 127
NIGHTINGALE SINGS	Apl. 14	Apl. 15	—	*Apl. 6*	—	Apl. 21	Apl. 27	May 10	—	Apl. 25. 106
CHURN-OWL SINGS	—	—	—	—	—	—	—	May 16	May 13	May 26. 60
YELLOW BUTTERFLY APPEARS	Mch. 14	Mch. 10	May 3	Mch. 16	Apl. 2	Mch. 23	Apl. 29	Apl. 8	Mch. 11	Mch. 17. 99
TURNIP IN FLOWER	—	—	—	—	—	Apl. 9	Apl. 17	Apl. 13	Apl. 29	Apl. 2. 92
LIME LEAFS	Apl. 14	Mch. 31	Apl. 17	Mch. 29	Apl. 20	Mch. 28	Apl. 14	Apl. 10	Apl. 24	Apl. 14. 103
MAPLE LEAFS	—	—	—	—	—	*Mch. 12*	Apl. 24	May 4	Apl. 8	Apl. 16. 60
WOOD ANEMONE FLOWERS ...	Mch. 29	*Mch. 4*	Feb. 25	Mch. 7	Mch. 30	Mch. 14	Mch. 18	Mch. 10	Mch. 11	Mch. 28. 96

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admirable Meteorological Notes communicated each year since 1882 to the Society by Mr. A. W. Preston, and printed in our 'Transactions,' and of which I have largely availed myself in the analysis which follows.

During the period from 1875 to the present time, the following phenomena have occurred on the earliest date recorded in the whole series, viz. :—

1882, three events in the month of March.
1883, one event in the month of February.
1884, two events in the month of April.
1893, two events in the months of March and April.
1894, one event in the month of February.

They were as follows:—

1882.

Oak leafed on 30th March, earliest of 114 observations.
Chestnut leafed on 15th March, earliest of 96 observations.
Wood Anemone flowered on 4th March, earliest of 96 observations.

1883.

Sycamore leafed on 25th February, earliest of 108 observations.

1884.

Cuckoo heard on 12th April, earliest of 127 observations.
Nightingale heard on 6th April, earliest of 106 observations.

1893.

Beech leafed on 2nd April, earliest of 117 observations.
Maple leafed on 12th March, earliest of 60 observations.

1894.

Frogs and Toads croaked on 22nd February, earliest of 121 observations.

We will consider each year separately :—

1882.—From the exceptionally early occurrence of three of the phenomena in the month of March we should expect to find that the Spring of the year 1882 was a very early one, and such was the case, for out of twenty-one occurrences observed, nineteen were earlier than usual; one, the building of the Rooks, a very erratic operation, happened precisely on the mean date of the series, and one only, the Cuckoo, was four days later than the mean date of

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its occurrence. Turning to Mr. Preston's valuable Meteorological Notes this is fully explained, for I find that January was an unusually warm and sunny month, with no snow and little frost, and the Crocus was in bloom on the 12th. February was dull and stormy, but very mild, with rain and S.W. winds; like weather prevailed during March and the first three weeks of April, this covered the period of all but two of our observations, which were, as might be expected, earlier than the average; but on the 21st of April the type of weather changed entirely, and a cold, wet, and stormy period continued till the end of the month, this accounted for the late arrival of the Cuckoo, which lagged behind till the 28th, and on the following day a furious and destructive gale from S.W. occurred; the unfavourable change was not of long duration, but the result was that the Hawthorn, which showed leaf at the unusually early date of the 23rd of February, did not bloom till the 3rd of May.

1883.—The Sycamore distinguished itself this year by coming into leaf on the 25th of February, being the earliest of 108 observations, the mean of the whole of which is April the 3rd, on which day it is recorded on five occasions. It is one of the earliest of our forest trees, but as I have already explained, I am inclined to think the circumstances which led to the event were exceptional. The year was not an unusually early one, 8 of the observations being earlier, and 10 later than the average; the Birch, Mountain Ash, Oak, Beech, and Chestnut all came into leaf about the normal time, the Ash rather earlier than usual, and the Sycamore was the only remarkable exception. The character of the weather during the Spring I have already referred to.

1884 was a very early year; 18 of the phenomena were earlier than the average, and only 4 later. The previous Winter had been very mild, and January also proved exceptionally warm; February was dry and mild, the only cold spell coming at the end of the month, which, however, lasted a very short time. In March was experienced almost Summer weather, and it was not till the 8th of April, after the bulk of the phenomena had been recorded, that ungenial weather with N. and N.E. winds set in and continued till the 9th of May. Of the 4 occurrences, which were rather later than usual, all but the flowering of the Snowdrop (16th January, one day late), a mere matter of situation, were such as generally

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take place after the 8th of April. The Rooks which were busy building on the 20th of February did not hatch till the 13th of April. The Swallow delayed its appearance till the 21st of that month, and it was not till the 11th of May that the first bloom of the Hawthorn appeared.

1893 opened with very severe weather, and much snow, which lasted till the 22nd of January, when it became mild and humid; this type of weather continued till the end of February. The first half of March was very bright and warm, but after that time the nights became exceedingly cold, seriously checking vegetation, which up to that time was in a very forward condition. Of the April which followed, Mr. Preston remarks, that it "will long be remembered for its warmth and bright sunshine as well as for its almost unbroken dryness; it was the warmest April since 1874, and the driest for more than half a century." Out of 26 observations 19 were earlier and 7 later than the average, but the features of the year were the exceptionally early leafing of the Beech (April 2nd), the earliest of 117, and of the Maple (March 12th), earliest of 60 observations. It is difficult to account for these very early occurrences, but it may have been due to conditions prevailing in the previous Autumn, favouring the ripening of the wood and preparing the leaf-buds for the forcing action of the exceptionally fine weather which prevailed during February and the first half of March, for certainly up to that date there was little to check their progress. The Birch, Elm, Chestnut, Hornbeam, Hawthorn flowering, Mountain Ash, Oak, and Lime, were all very early, especially the three last, but the Hawthorn leafing was eight days, and the Sweet Chestnut six days later than usual. It is, however, worthy of remark that though the Hawthorn was not in leaf till the 18th of March, so forcing became the weather that it flowered on the 22nd of April, and several other events were accelerated in like manner. The Rooks which commenced building on the 25th of January, a month earlier than usual, had not hatched till the 5th of April, which was only five days earlier than their average for 118 records.

1894, although a fairly early year, does not call for very special notice. The only remarkable incident is the date on which the Toads and Frogs commenced their amorous notes, viz., February 22nd, just a month earlier than the average of

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121 observations, which gives the 22nd of March. This, I think, is accounted for by the sudden burst of mild weather, which took place on the 10th of January, and was intensified in the next month, the warmest February since 1884. Of the 26 phenomena recorded in 1894, eighteen occurred earlier than the average; one, the leafing of the Lime, on the 14th April, which date is the mean of 103 observations, and 7 others later than the average; these latter, with the exception of the cooing of the Ring Dove (March 1st), which may take place on any sunny morning, and is a sign of no importance, all took place during the month of April, and, possibly, may be accounted for by the dry weather which prevailed up to the middle of that month. The Hawthorn was again in flower before the end of April, the first blossom being recorded on the 26th of that month; and the Rooks which began to build on the 20th of February, twenty-six days later than in 1893, had young ones on the 8th of April, only three days later than in that year.

Of the years in which the latest records of any of the phenomena took place I may mention:—

1881 and 1898.

The Swallow appeared on the 2nd of May, the latest of 118 observations.

1892.

Thrush song commenced 20th of March, the latest of 105 observations.

1899.

Elm leafed on 17th of May, the latest of 92 observations.

1881.—After an exceedingly mild December, January came in very favourably; this weather continued till the 18th of the month, when there was a violent gale from E.S.E. accompanied by heavy snow and intense frosts which continued throughout the month. It was the coldest January since 1838, the mean temperature being 30·4°. February followed cold and unsettled; vegetation at the end of the month having made very little progress. March, although upon the whole dry and fine, was accompanied by occasional falls of snow, and sharp frosts were experienced in the last week. The result was a very backward Spring, and out of 21 records, 13 were later than the average. The Lime was in leaf at its usual time, and the Chestnut a few days

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earlier than the mean, but all the other forest trees were late. A few unimportant occurrences such as Frogs croaking, Rooks commencing to build, and the Yellow Butterfly appearing, all of which might happen as the result of the first few warm sunny days, were all slightly earlier than usual; but, strange to say, the song of the Nightingale was heard on the 14th of April, eleven days earlier than the mean; but the Swallow showed more discretion, and did not put in an appearance till the 2nd of May, the latest date in the whole series of 118 records.

1892.—The Spring of this year was cold and ungenial. The last week in January and first half of February, although mild, were foggy and unpleasant; the rest of the month and the whole of March were cold and winterly. April opened fine and warm, but on the 15th there was a very heavy fall of snow, and till the end of the month the weather was very cold, although interspersed with occasional Spring days, and this continued till the 7th of May, when seasonable weather set in. We are not surprised, therefore, that the Thrush withheld its song till the 20th of March, the latest date recorded for its commencement out of 105 observations, and that of 16 recorded phenomena 13 were later than normal, and only two occurred on earlier dates than the recorded mean: these were young Rooks which were hatched on the 31st of March, and the Swallow which appeared on the 12th of April during a warm spell which ended in a severe snow storm on the 15th, and proved very disastrous to these useful birds. The Oak leafed on April 24th, the mean of 114 observations.

1898 was about an average year; out of 27 observations 13 were earlier and 14 later than the mean; these latter pertain generally to those which occur in the months of April and May, and the most remarkable is the late arrival of the Swallow, which, in 1881, and again in this year, is not registered till May 2nd, the latest arrivals in 118 observations; but the Cuckoo was heard on the 23rd of April, its usual time. Those phenomena in April which were slightly earlier than usual, as the leafing of the forest trees, were such as would not be greatly influenced by rapid changes of weather, and were therefore not seriously deterred by the rough spell in the end of March, but which was soon succeeded by bright weather and seasonable showers, lasting till the middle of April. May was a cold and ungenial month.

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1899.—The last week in January and the whole of February were very variable, though on the whole favourable to vegetation; but the middle of March brought very rough weather with heavy and continuous snows, and it continued very cold till the end of the month. April was wet and sunless, and ungenial weather continued throughout the month of May. Of the 25 phenomena observed, 2 occurred on the days of their mean, 8 were earlier, and 15 were later than their average, in these latter were included all the forest trees except the Maple, which was eight days earlier than usual. The remarkable feature was the late leafing of the Elm, which is not recorded till the 7th of May, the latest of 92 observations. The 30th of March is the mean date of the leafing of this tree, but it will be seen (Table II) that in 1832, and again in 1852, it was in leaf as early as the 8th of February, showing a difference between the two extremes of 98 days, a very wide margin. The extremely mild weather of January greatly favoured early vegetation, but Mr. Preston records that, contrary to what might have been expected, the Winter Aconite and Snowdrop did not make their appearance at Brundall till eighteen and nineteen days later than in the year 1898; this he suggests might have been owing to the drought of the previous August and September, but it is worthy of note that the latter flower at Stratton appeared on the 10th of January, one day later than in the previous year.

In the accompanying table (No. II) the earliest and latest occurrences of each "Indication" are given with the years on which they happened, followed by the number of observations and the mean date of each occurrence, and in the last column the years in which the event happened on the mean of the whole series of its observation.

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INDICATIONS OF SPRING

OBSERVED AT AND NEAR STRATTON STRAWLESS, NORFOLK

COMMENCED BY ROBERT MARSHAM, F.R.S., IN 1736, AND CONTINUED

THE REV. H. P. MARSHAM, AT RIPPON HALL (NEXT PARISH), IN 1836; BY W

IT WAS BROUGHT UP TO THE YEAR 1

Indication.	Earliest Occurrences.	Latest.	Difference.
SNOWDROP FLOWERS... ...	December 15, 1838	February 17, 1803	64 days
THRUSH SINGS	Nov. 20, 1856, '65	March 20, 1892	120 ,,
HAWTHORN LEAFS	January 27, 1804	April 22, 1784	85 ,,
HAWTHORN FLOWERS ...	April 15, 1854	June 8, 1799	54 ,,
TOADS AND FROGS CROAK...	February 22, 1894	April 26, 1849	63 ,,
SYCAMORE LEAFS	February 25, 1883	May 4, 1771	68 ,,
BIRCH LEAFS	March 4, 1750, '79, 1848	May 4, 1771	61 ,,
ELM LEAFS	Feb. 8, 1839, '52	May 17, 1899	98 ,,
MOUNTAIN ASH LEAFS ...	March 5, 1779	May 2, 1871	58 ,,
OAK LEAFS	March 30, 1882	May 20, 1799	51 ,,
BEECH LEAFS	April 2, 1893	May 10, 1771	38 ,,
HORSE-CHESTNUT LEAFS ...	March 3, 1849	May 2, 1771	60 ,,
CHESTNUT LEAFS	March 15, 1882	May 18, 1855	64 ,,
HORNBEAM LEAFS	February 8, 1852	May 7, 1771	88 ,,
ASH LEAFS	April 2, 1779	May 26, 1772	54 ,,
RINGDOVE COOS	December 25, 1857	April 15, 1857	111 ,,
ROOKS BUILD	January 7, 1836	March 19, 1745	71 ,,
YOUNG ROOKS	March 23, 1846	April 24, 1853	32 ,,
SWALLOW APPEARS	April 5, 1761, '63	May 2, 1881, '98	27 ,,
CUCKOO SINGS	April 12, 1884	May 7, 1767, '99	25 ,,
NIGHTINGALE SINGS... ...	April 6, 1884	May 19, 1792	43 ,,
CHURN-OWL SINGS	April 27, 1869	July 9, 1853	73 ,,
YELLOW BUTTERFLY APPEARS	January 14, 1790	April 29, 1862, '66	105 ,,
TURNIP IN FLOWER	December 26, 1846	May 14, 1784	139 ,,
LIME LEAFS	March 19, 1794	May 12, 1746	54 ,,
MAPLE LEAFS	March 12, 1893	May 7, 1770, '71	56 ,,
WOOD ANEMONE FLOWERS...	March 4, 1882	April 30, 1837	57 ,,

June 15th, 1900.

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XVII.

ON THE OCCURRENCE OF *ÆCIDIUM ELATINUM* IN NORFOLK.

By W. H. Burrell.

Read 26th February, 1901.

Some eighteen months or two years ago, Mr. Upcher's forester, Harry Smith, called my attention to an abnormal growth on a Silver Fir on the Sheringham Hall Estate. The growth, which was twenty-eight inches high and thirty inches at its greatest breadth, was seated upon a secondary branch, two or three feet from the ground; in appearance and habit it differed considerably from the parent tree; the leaves were deciduous, of a pale yellowish green colour, acute at apex, and were developed all round the twigs, instead of being persistent, dark green, emarginate, and complanate. At first sight one would have thought the growth was in a sickly condition, but a close examination showed that the terminal buds were well developed, and the twigs vigorous and full of sap, so that they could easily be bent into a circle without breaking. Smith ventured the opinion that it was some kind of fir parasitic upon the Silver Fir, and that there was nothing else like it on the estate.

During 1899 and 1900 the growth was watched at intervals, and notice taken of the fall of the leaves in autumn; the early development of the buds in spring, some weeks ahead of the normal leaf-buds; and its steady growth, it being thirty-two inches high and thirty-four inches across on December 1st, 1900; but no clue was gained to its real nature till later in December, when I happened to see a description of Witches brooms that agreed so well with

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the tree at Upper Sheringham that I felt sure the mystery was solved.

Before dealing further with the subject of this note, it will not be out of place to make a few statements concerning (*a*) Witches brooms in general, and (*b*) the family to which the specific fungus of the Silver Fir broom belongs.

Witches brooms are found on a number of trees, including Beech, Fir, Pine, Larch, Birch, Hornbeam, Bullace, Cherry, and are a sign of disease; they are the external evidence of parasitic fungi which form perennating mycelia in the tissues of the host. These parasites have a stimulating effect, causing enlargement of individual cells in the affected region, and the formation of abnormal tissues. Kerner's description is so graphic that I cannot do better than quote him; he selects the growth on Silver Fir as the type, and says: "It always grows on one of the horizontally projecting lateral branches of the Fir, and raises its erect or curved twigs from the upper side, resembling, as it were, an epiphyte growing on the bark of the horizontal bough. The twigs are grouped in whorls, and not in two rows as usually happens in the lateral shoots of the Silver Fir. They are all shortened and thickened, and remarkably soft and pliable, because the cortical parenchyma has become spongy and the wood is only slightly developed. The buds, which in healthy tissues are egg-shaped, are almost spherical here. As in other instances of hypertrophied plant-members we have a precocious development, a so called 'prolepsis' in these Witches brooms. The buds swell earlier and unfold earlier than those of healthy twigs. The leaves remain short, yellow, somewhat crumpled, and fall off when a year old, while those of normal twigs are long, linear, straight, dark green on the upper side, and remain in position from 6—8 years. The growth of the twig is restricted; it dies off in a few years, and then inserted on the dark green branches of the Silver Fir remain the dry bristling brooms, whose appearance has stimulated the imagination of the peasantry, and given rise to the superstition as their name testifies * * * * * that their origin was connected with witches."

Æcidium elatinum, the cause of Witches brooms on Silver Fir, belongs to the Uredineæ. As you are aware, all the members of this family are parasites, living in the tissues of phanerogams and ferns. Plowright names over three hundred and sixty host plants,

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both great and small, from the humble daisy to the forest tree, that are attacked by them. The mycelium may be short-lived or perennial, and may be limited to a small spot on a leaf or to one of the reproductive organs, or it may permeate the whole plant, root, stem, and leaves. Its effect on the host may vary from a slight and transient disfigurement to the total destruction of the plant. The Uredines are notable for two characteristics, (*a*) the variety of their reproductive cells, and (*b*) the heterœcism of some of their members.

(*a*) The most fully equipped species produce three distinct kinds of spores, æcidiospores and uredospores, each giving rise to a mycelium on germination; and teleutospores, first producing a promycelium, from which conidia are abstricted, and these conidia give rise to true mycelia.

(*b*) The Uredines are the only known plants in which an enforced change of host occurs (metœcism). A number of species are unable to complete their life cycle without migrating at definite periods from one host plant to another of a different genus.

Both these peculiarities appear in the historic *Puccinia graminis*. The æcidiospores occur on the leaves of Barberry; these spores will not develop on Barberry, but can produce a mycelium only in the tissues of the grasses, on the leaves of which uredospores and teleutospores appear later. The teleutospores in their turn cannot develop in the tissues of grasses, but have to migrate to Barberry. Although the devastation caused by these parasites has troubled agriculturists for ages, the true cause of rusts and smuts has only been discovered in comparatively recent times. Since 1864, when De Bary first recognised the dual existence of *Puccinia graminis*, a number of workers have given attention to the subject, and much progress has been made in the study, but there are at the present time between thirty and forty members of the family (Uredineæ) whose life history is not completely known.

Amongst these imperfectly known forms is *Æcidium elatinum*. The æcidium stage only is known. Whether under favourable conditions uredo and teleuto spores are formed, and whether it is autœcious or heterœcious, are botanical problems which remain to be solved. Its mycelium is perennial in the cortical and bast tissues of the Silver Fir; its mode of entrance is unknown. Weise believes

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that infection takes place in twigs which have just escaped from the bud. Hartig suggests that the germ tube gains an entrance through wounds in the cortex. If a bud capable of development exists near the point of entrance, the mycelium keeps pace with its growth, modifying its structure as previously described, and causing a Witches broom; if no bud be present a canker is formed, but in either case the effect is limited, the tissues on either side of the gall remaining normal.

The leaves produced on the affected twigs are pale yellowish green, from the almost entire absence of chlorophyll. On the upper surface spermogonia appear about May; a month or two later æcidia are formed on the under surface, and the leaves commence to fall in August when the æcidiospores have dispersed. The internal structure of the leaves undergoes proportionate changes. As it was not till December that I had any clue to the nature of the growth, I have only had an opportunity of examining the few leaves, which probably, from their late development, escaped the more vigorous attacks of the fungus and retained their position till mid-winter. These show a very feeble development of the two central vascular bundles; the resin ducts and palisade-parenchyma of the upper surface are suppressed, and an orange-coloured stain which occurs here and there shows through the lower epidermis as a double row of rust spots. I have not been able to detect in these leaves any clearly defined basidia, spores, or pseudoperidial cells.

There are an appreciable number of diseased trees in the neighbourhood of Sheringham. On Mr. Upcher's estate there are some half-dozen brooms. Westward, on the Weybourne Hall estate, there are very few Silver Firs, and these appear to be clean. Eastward, the search was more productive; single brooms here and there led to a patch of woodland on the adjoining estates of Mr. Cremer and Sir Samuel Hoare, where there are at least fifty trees affected, and from there I have traced isolated cases through Beeston Regis to Aylmerton. An afternoon at Hempstead, near Holt, gave no definite results. One tree had a suspicious looking growth which was too high up to examine closely, and two or three other trees had cankers and dead brooms, but in the absence of well-marked characters I hesitate to refer them to *Æcidium elatinum*.

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I have had considerable difficulty in forming an opinion as to the prevalence of *Æcidium elatinum* in Great Britain. Hartig states that "it is common in the South-West of Scotland;" and the editor of the English edition of Tubeuf says, "it is common throughout Britain;" but there is little evidence to support this latter statement. Professor Marshall Ward has found it in Surrey. Dr. Somerville says it is common in the North of England; and Professor J. Bayley Balfour verifies Hartig's statement that it is common in the South-West of Scotland, and also in Fifeshire, but there appear to be no other records south of the border. There are no English records at the Royal Botanic Gardens, Kew; nor at the Royal Botanic Garden, Edinburgh.

I am indebted to Dr. Plowright for examining a specimen and verifying it; and also to Professor J. Bayley Balfour, Mr. Massee, Dr. W. G. Smith, and Professor Marshall Ward for the assistance they have given me in tracing records.

Records of the researches into the life-history of the fungus will be found in—

'Comparative Morphology and Biology of the Fungi.' De Bary.

'Diseases of Trees.' Hartig.

'Natural History of Plants.' Kerner.

'British Uredineæ.' Plowright.

'Diseases of Plants induced by Cryptogamic Parasites.' Tubeuf and Smith.

'Saccardo Sylloge.'

P.S.—Since February I have detected *Æcidium elatinum* in the following additional localities: Hempstead (near Selbrigg and at Pond Hills); Kelling, Matlask, and Blickling (in the Hercules covert).—W. H. B., July 8th, 1901.

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XVIII.

NINETEENTH CENTURY RAINFALL.

By F. Dix.

Read 26th February, 1901.

On the 26th February, 1901, F. Dix exhibited a chart of the rainfall during the past one hundred years, 4 feet 7 inches wide by 3 feet 3 inches deep, which was headed, "The Monthly, Half-yearly, and Yearly Rainfall, during the Nineteenth Century in the East of England," compiled by Francis Dix; including 1801 to 1831 by Luke Howard at Tottenham (see 'Climate of London'), 1832 to 1838 by Mr. Squire at Epping (see 'Moore's Almanack'), 1839 to October, 1874 at Dickleburgh, and October 1874 to December 31st, 1900, at No. 1, Essex Street, Norwich, by Francis Dix.

This chart was ruled in 100 divisions from left to right, each division was headed by the date of the year with the monthly rainfall, that of the first and last six months, and the rainfall of the year entered thereunder.

The lower portion of the chart was ruled for two feet with lines one inch apart, showing by up and down black lines the variation of rainfall from year to year, which amounted between 1847 and 1848 to 14.02 inches, and between 1864 and 1865 to 13.26 inches. The lowest rainfall was shown to be 14.21 inches in 1864, and the greatest yearly rainfall to be 33.34 inches in 1882, a difference of 19.13 inches.

The average of the first 50 years in South Norfolk that was registered by F. Dix between 1838 and 1888, thirty-five years and nine months at Dickleburgh, and fourteen years and three months at Norwich, was shown on the bottom line as follows:—

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1.72	1.57	1.58	1.44	1.70	1.83	2.55	2.25	2.34	2.95	2.52	1.97

First 6 months, 9.84 in. Last 6 months, 14.58 in. Yearly average, 24.42 in.

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The following summary was attached giving various particulars relating to the rainfall during the century ending December 31st, 1900.

100 YEARS' RAINFALL IN THE EAST OF ENGLAND.

	First 6 months. inches.	½-yearly. inches.	Last 6 months. inches.	½-yearly. inches.	Total In 31 years. inches.	Yearly inches.
Years 1801 to 1831. 31, at Tottenham, Howard's 'Climate of London.'	330.45	10.66	449.64	14.50	780.09	25.16
1832 to 1838. 7, at Epping, 'Moore's Almanack,' By J. Squire.	73.03	10.43	97.68	13.95	In 7 years. 170.71	24.38
1839 to 1874. 36, at Dickleburgh, By F. Dix.	345.24	9.59	484.37	13.45	In 36 years. 829.61	23.04
1875 to 1900. 26, at Norwich, By F. Dix.	272.37	10.47	417.03	16.04	In 26 years. 689.40	26.51
Years 1801 to 1900, 100, Aggregate	1021.09	10.21	1448.72	14.48	100 years Total. 2469.81	Mean yearly 24.69

Greatest Yearly Rainfall, 33.34 in. in 1882. Least Yearly, 14.21 in. in 1864.
Average Rainfall first 50 years, 24.97 in. The last 50 years, 24.42 in.

100 YEARS' MEAN MONTHLY, QUARTERLY, SUMMER AND WINTER RAINFALL IN EAST OF ENGLAND, TO DECEMBER 31ST, 1900.

	inches.	Quarterly inches.	
4th Month (April)	1.56		
5th Month (May)	1.77	5.25	
6th Month (June)	1.92		inches
7th Month (July)	2.56		12.26 in Summer half-year.
8th Month (Aug.)	2.26	7.01	
9th Month (Sept.)	2.19		
1st Month (Jan.)	1.78		
2nd Month (Feb.)	1.59	4.95	
3rd Month (March)	1.58		12.53 in Winter half-year.
10th Month (Oct.)	2.88		
11th Month (Nov.)	2.55	7.58	
12th Month (Dec.)	2.15		
		24.79	Mean Yearly.

The small difference between the first 50 years, 24.97 inches, and the last 50 years, 24.42 inches, show that 50 years' register in one place is long enough to arrive at a fair average for that station.

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XIX.

NOTES ON THE HERRING FISHERY OF 1900.

By T. J. Wigg,

Honorary Secretary Great Yarmouth Section.

Read 26th March, 1901.

The annual Herring Fishery has of late years grown to such enormous proportions, that even the increased space marked out on the South Denes at Yarmouth has been found too small for the inrush, and the Town Council has been obliged to set apart more spaces for firms who yearly find Yarmouth a good field for operations. A feature of this year's fishing is the great number of steam-drifters fishing out of Yarmouth. Some of them are fine boats, and travel fast, and it is a grand sight to see them scudding about among the other and slower craft. Wind and tide do not affect them, and they make much quicker voyages than did the old-time luggers. Since the last fishing a number of large fishing premises have been erected on the Denes by well-known Scotch firms. These are replete with all the most recent improvements. Owing to the large number of boats fishing from Yarmouth, there has been some difficulty to find berths for all comers; and many of the steamers, after disposing of their cargoes, were obliged to move much higher up the river; while some of the Scotch craft have, at times, been obliged to land their Herrings on the Quay near the Town Hall (about a mile from the Fish Wharf).

In connection with this year's fishing it is worth noting that there were in port a far larger number of Scotch boats than has hitherto come to Yarmouth.

The Herring Fishery is growing year by year, being fostered by

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the Corporation as an industry greatly to be encouraged and provided for. This year no less than 404 Scotch boats have been working out of this port. The flotilla represents 12 North British ports. No fewer than 111 hail from Banff, Kirkcaldy sends 65, Leith 44, Fraserburgh 43, Inverness 39, Berwick 32, Montrose 21, Wick 20, Peterhead 17, Aberdeen 6, Arbroath 4, and Stornoway 2. The crews of these boats (many of which carry eight hands) amount to nearly 4000 men; and to prepare the Herrings for market, as they alone can prepare them, there is a small army of nearly 2000 Scotch women. Add to these some 200 or 300 fish buyers, and some idea may be formed of this great industry. These numbers are augmented considerably if we take into consideration the local women who work in the fish-houses, and all the men who are employed as carters, packers, tallymen, salesmen, checkers, bellmen, and clerks.

A remarkable feature of the growth of the Herring industry has been the export trade. A few years ago two or three schooners would suffice to convey the Herring away to the north and south ports, there to be re-shipped on steamers for foreign ports. But all this is now changed. Sailing vessels still load weekly at the Quay, but the bulk of the Herrings is now sent off by steamers. Four fine German steamers belonging to one company have been among the arrivals, and this may be considered as rather out of the ordinary course of events. Besides these there are steamers from Norway and Sweden. Each of these steamers loads up some thousands of barrels for foreign consumption.

During the latter part of the Herring Fishery the boats encountered some very rough and stormy weather, and many were to be seen with tattered sails, smashed bulwarks, and, in some cases, loss of masts; and several arrived with their nets on deck full of Herrings, just as they had been hurriedly dragged on board. Some of the catches have been phenomenal. One lugger delivered at the Fish Wharf no fewer than 198,000 Herrings, or 15 lasts, which sold for £215. This return to her owners and crew, for a single fishing, is probably the best result obtained during this year's Herring voyage.

The experiment inaugurated last year, when a number of sites on the South Denes were let by public auction as pickling plots for the Herring season, proved most successful—a rental of £1200 being

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realised. It is thus apparent that the Yarmouth Corporation has found a new and most reliable source of income. This year ten less sites were offered, but the gross rentals amount to £1320.

A description of a remarkable scene in the Harbour appeared in the 'Yarmouth Independent' of October 27th, 1900:—"Owing to the rush of some 400 Scotch boats into the Harbour on Saturday, the space in front of the Fish Wharf at the north end was the scene of a considerable crush; about a score boats, a steamer, and a schooner getting entangled. At one time it appeared almost possible to walk from deck to deck quite across the river. After a time a few steam drifters were got out. This eased the pressure, and the 'block' was removed, but the sailing craft were handicapped by a strong tide. Although there are invariably large numbers of fishing boats every morning during the fishing season going seaward, provided the weather is favourable, there is always a rush on Monday mornings, owing to the fact that the Scotchmen do not fish on Sundays, but all must commence their week's work on Monday morning."

The Herring Season of 1899 was looked upon as the best and most remarkable season on record. The number of fish caught went up by leaps and bounds, and at the end of that season the total was over 26,000 lasts. Owners and men were proud of the great harvest yielded by the sea. Great, however, as that harvest was, it has been beaten by the total of Herrings caught in 1900, which stands alone as the record year of the fishing as well as the last year of the century.

RETURN OF HERRINGS LANDED AT YARMOUTH IN 1900.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	265
February	—	July	251
March	4	August	603
April	15	September	1,708
May	28	October	10,365
June	218	November	12,589
		December	3,219
Carried forward	265	Total	29,000

September	1,693	+ 15	Scotch.
October	3,314	+ 7,051	„
November	6,225	+ 6,364	„
December	3,141	+ 78	„

420 Scotch and 150 Home Boats.

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RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1900.

Month.	Lasts.	Month.	Lasts.
January .	—	Brought forward	1,345
February .	—	July . .	349
March . .	97	August . .	7
April . .	379	September .	143
May . .	464	October . .	6,281
June . .	405	November .	8,904
		December .	3,234
Carried forward	1,345	Total .	20,263

Number of	Lowestoft boats . . .	213
„	Scotch „ . . .	230
„	West Country boats . .	9
		452

ADDITIONAL NOTES BY MR. A. PATTERSON.

THE marked absence of the natural and formidable enemies of the Herring, which in the Fishery of 1899 seemed to be conspicuous, applies equally to the present season. Birds in particular have been scarce, although Gulls of various species have been seen in great numbers. I was much struck by the vast assembly of Gulls that made Breydon mud-flats a mass of life on October 28th, 1900, when hundreds, evidently wearied by some rough weather which was experienced at that time, swarmed the place. There were many magnificent specimens of the Greater and Lesser Black-backed Gulls (*Larus marinus* and *L. fuscus*), besides others in all stages of plumage; the Herring Gulls (*L. argentatus*), both old and young, were also numerous. A few Little Auks (*Mergulus alle*) certainly turned up in November; but they may have been more bent upon Sprat banquets than a feast of bloaters. A Cormorant was shot on the North river early in October. It had evidently left its quest of Herrings for a change of diet.

Briefly summarised, the following are a few of the things which I thought worthy of notice. No Grey Mullet (*Mugil capito*) appear to have been netted, and no Salmon Trout (*Salmo trutta*). A Salmon of 22 lbs., in splendid condition, although at that time technically unfit, was entangled in a Herring net on October 13th. A few Surmullets (*Mullus surmulletus*) were caught with Mackerel, but the latter were not so eagerly pursued this year—fewer boats going out. As the Dory (*Zeus faber*), the Sea Breams (*Pagellus*),

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the Garfish (*Belone vulgaris*), the Scad (*Caranx trachurus*), and allied species consort with *Scomberidæ*, we obtained fewer of these.

Some enormous Mackerel were taken, but I saw none of the rarer varieties, as the Scribbled Mackerel. Few Dog Fish followed the Herrings this year. The reason of this apparent falling off of the rapacious fishes of late years I am unable to give. Two Sharks of the Porbeagle (*Lamna cornubica*) species were taken, one of which was exhibited in the streets. This was in November. Its length was 7 feet 6 inches. The first, a 6 feet specimen, had its mouth stuffed with torn net that it had ripped in its efforts to escape.

I am told that an unusual number of Sprats has been entangled in the Herring nets, thus showing the occasional commingling of the species. Some of the Herrings have been of very large size and one was shown to me which measured 15½ inches in length—the largest, I believe, ever recorded here. The only cetacean seen was one cast ashore at Scratby, on December 3rd. This was an adult Lesser Rorqual, or Pike-headed Whale, a species which is devotedly attached to the Herring as well as to other round fishes which it comes across.

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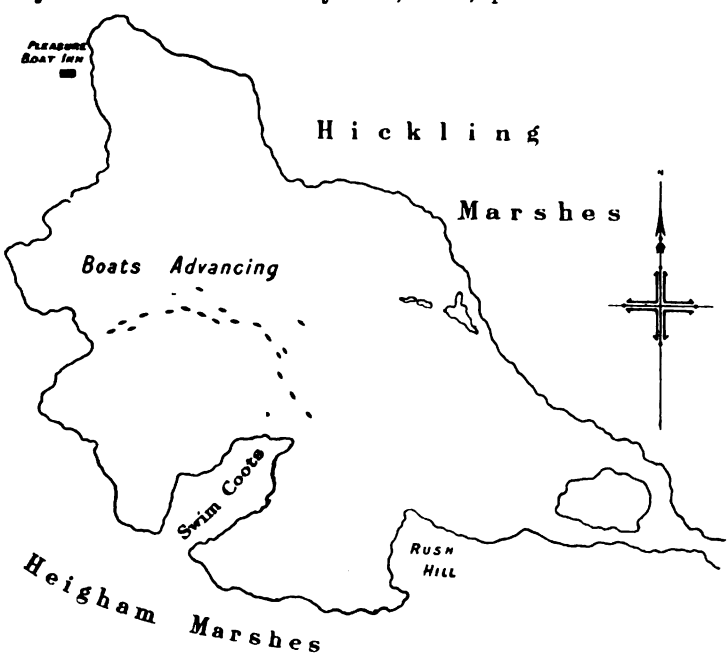
XX.

COOT SHOOTING ON HICKLING BROAD.

By J. H. Gurney, F.L.S., V.-P.

The custom of attacking Coots (*Fulica atra*, L.) when collected in large bodies in winter has been carried on upon Hickling Broad for many years, but is seldom if ever attempted on the smaller Norfolk Broads. It has also been tried with great success at Slapton Ley in Devonshire. February 25th, 1901, provided the ice had



gone, being the last day for this season, I availed myself of the invitation of a friend to accompany the Coot shooting party, but took no gun. The *modus operandi* was as follows: At 10 a.m. nineteen armed boats, each with one shooter and a man to "quant" him, for the Broad is very shallow which is no doubt one attraction

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to the Coots, and two more boats to pick up the slain, sallied forth from the north end of the Broad, and forming themselves into a line, advanced in crescent shape upon the Coots, of which there were about 3000, by the Rev. M. C. H. Bird's estimate, and he judged that this was a larger number than he had ever seen on the broad before. Hickling Broad, formerly estimated at 700 acres of water, now at little more than 400, is irregular in outline, as will be seen by the accompanying map, prepared with Mr. Southwell's assistance, and this is not favourable to the Coots, as it facilitates their being easily driven into one of the bays. That chosen for the first drive was against the promontory appropriately known as "Swim Coots." Towards this the Coots swam, but finding themselves pressed, after a few minutes' indecision they rose, not quite *en masse* I understand, but four or five at a time, and flew back over the boats.

Unfortunately, I did not arrive in time to see the first drive when the pack was at its densest, but Mr. Bird described to me the clattering, spluttering roar with which the sooty mass left the water, mounted to the wind, hung there for a moment, and then with legs stretched out behind (looking and acting like a tail) scattered in every direction amid a general discharge of fire-arms. In this sort of sport the great thing is to keep a good line, for if a gap is left the Coots make for it as I plainly noticed, and should any boat for selfish reasons try to better its position at the expense of the rest, it would probably spoil the day's amusement. Or again, if boats stop to pick up the killed there may be the same result, and it is better to gather them afterwards, as was done on this occasion.

In 'The Birds of Norfolk,' the late Mr. Henry Stevenson, writing of these Hickling Coot-shoots, speaks of the Coots being driven out of the Reed beds and bushes on to the water, but this was not what I saw, and Mr. Bird remarks that such a method of attack would only be necessary if the waters were high, and the battue early in the year before the leaf was off the Reed; at other times they are always to be seen swimming about.

On rising, Coots strike the water with their toes, which at first hang down, but when once up, these birds, though they look ungainly, are capable of very strong and protracted flight, in fact, they are known to cross the North Sea. Although they do not

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fly very fast they are exceedingly tough, being defended with a black armour of feathers and down (this latter as in the Moor-hen existing from infancy), through which No. 5 shot will hardly penetrate.

As usual, nothing would make them quit their beloved Hickling Broad, and again and again the same "ruse" was tried, but the poor Coots could not grasp the situation. They were driven first to one end and then to the other, and had to run the fusilade or die on the water, but I saw none shot swimming. It was a still day, but if there was much wind I should think the Coots would be wild, especially if they had already been shot at once or twice. The tenacity with which they cling to their lake is probably in part because they are day feeders, for at night Coots often fly long distances of their own accord, when their cry can be heard in the darkness, and in the south of France it has been noticed on the Rhone that after a battue of this kind, when night comes the bulk of them go away.

I only saw one Coot actually quit the water and go away inland, but some were flying aimlessly round the edge, and these had to reckon with concealed gunners on the bank. Including what were killed by the latter, the total bag, as far as it could be totalled by Mr. Bird was 910, and that gentleman, to whom I am indebted for many particulars, considers this the largest bag ever made. A great many Pochard Ducks were also flying about, but they were much wilder than the Coots and only three were brought to bag, though Mr. Bird and I estimated the number at quite 400. I learn from that gentleman that of the 910 Coots, 683 were shot by the flotilla of boats, and 75 by two boats stationary at the entrance to Heigham Sounds, and the rest by people on shore, to which I may add that I saw an evident poacher making off with a few which were not of his own shooting.

Several circumstances contributed to the day's success, but Mr. Bird thinks what chiefly accounted for this unprecedented show of Coots was the fact of the channel through Hickling Broad having been kept free from ice by the passage of wherries. This too would induce many Coots from smaller broads which had become frozen during the recent hard weather to retreat to these congenial open "wakes" at Hickling.

Mr. Bird is also of opinion that many more Coots nest round

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Hickling than was the case ten years ago,* partly the result of watching carried out by Mr. Smith and Mr. Dawson, and also because since May 1st, 1895, their eggs have been protected by law. Whether any of these home-bred birds helped to swell the numbers which we saw, I confess I think is very doubtful, as they are birds of pronounced migratory habits. Some broad owners are not partial to Coots, considering, with Mr. G. C. Davies, that they drive Wild Ducks away, and scatter the young broods.

Nine hundred and ten may be a record bag for Norfolk, but large as it is, it has been considerably surpassed at Slapton Ley in Devonshire, in the Pontine marshes of Italy, and at the mouth of the Rhone (R. Orn. du Midi de la France. Nouv. Souv. de chasse dans le Midi de la France). In the Pontine marshes (Campagna di Roma) the Duke of Sermoneta bagged 2226 in one day (Badminton Library, 'Shooting'), an extraordinary bag, and it is to be hoped a use was made of them.

Mr. Bird heard that all day long, while the firing, which was like a battle-field, was going on, Coots and Pochard Ducks were passing to and from Hickling and Horsey Broads—a distance of 1½ miles—where three guns ran up a bag of 37 and 4 Pochards, but no doubt several boats would have done a good deal more on Horsey. The day was fine though the Coots were wild.

I confess it was rather repugnant to the feelings of a naturalist to see so many of these birds shot, but I was glad to learn that all this killing is by no means for nothing, as the country people are delighted to eat them. The supply the following year does not seem to be affected, and on the present occasion about 2000 were left for stock. Colonel Hawker says that Coots should be soaked all night in water, but without this process I have found them oily. On the coast of Suffolk there are, or used to be, people so partial to Coots

* In 1881 Coots had so diminished that it was quite possible to go to Hickling, Horsey, Filby, Ranworth, Breydon, and Fritton, without seeing one, as the following memoranda show:—July 1st, 1881, only two Coots on Hoveton Broad, and one on Wroxham. July 6th, sailed over the whole of Hickling and Horsey without seeing one. August 31st, have been twice to Heigham Sounds, and once to Ranworth and South Walsham, and seen one Coot each time. November 9th, one on Surlingham, none on Filby, only one or two on Breydon and Ranworth. In 1882 and 1883 I found their numbers very little increased on different occasions of visiting the Broads.

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that Fenwick Hele says women were regularly employed at Aldeburgh in preparing them.

Among the slain, I am sorry to say, there was a Great Crested Grebe, already assuming breeding plumage, and a Sclavonian Grebe, whose eye exhibited the usual red and golden circles.

The opportunity of examining such a large series, though I did not inspect nearly all of them, led to the following conclusions:—Some Coots are much larger than others, blacker in plumage, have bigger shields and yellow garters, and more white on the wing. These giants are well known to the fenmen, and some of them, Mr. Bird finds, weigh one pound more than the small race, and he adds that there are always two sizes of Coot's eggs to be found in summer, which Stevenson corroborates, the inference being that the big birds lay the big eggs. It was certainly excusable in the old naturalists to make two species of the Coot, but many other species, *e.g.*, the Water Rail, Wheatear, Ringed Dotterel and Dunlin, vary quite as much in size, yet no line can be drawn, which would sufficiently discriminate between the big and the small, and after all they do not differ more than human beings.

The Coot's beak and shield are generally described as pale flesh-colour, and in one plate the shield is bright red, but at this time of the year they are without exception of the purest ivory white, and the mouth and tongue also. Not one showed the slightest approach to knobs at the apex of the shield, which characterises the Crested Coot.*

The feet and scalloped toes of a Coot are not green but very dark gray, and legs, toes, and claws are so strong that they are able to hold on with great tenacity,† so much so that a wounded Coot clutched at and then clung on to my man's trousers as if it would have torn them. I can testify to the agility with which some of the wounded ones dived, and so mysteriously do they sometimes disappear that one cannot but believe the common story of their clinging to weeds under the water, and preferring to die there.

* Another allied species, and one perhaps more likely to be detected in England, is *Fulica americana*, distinguishable by its white lateral tail-coverts.

† On one occasion a Coot was discovered either entangled or clinging by its legs to the signal cord of a railway carriage at Thorpe Station (Zool. 1885, p. 56).

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The feet in a very young Coot develop far more rapidly than the wings, being already three-quarters grown when the little winglets are barely an inch long.

The first Hickling Coot-shoot of the season is generally in November, and it is the custom to attack them two or three times during the winter, but the end of February is rather too late, as Coots pair in February when it is fine, though they do not begin to nest awhile.

In a long continued frost, Coots which have not migrated stand a good chance of being starved. At such times they may be seen with feathers puffed out and heads drawn in, the most miserable of objects, standing helplessly on the ice, and if one is shot the rest make little or no attempt to escape, and I am ashamed to say, when I was a boy, this sort of sport had for me its attractions. Such weather would not be very favourable for a "battue" at Hickling Broad, but on one occasion, the day having been fixed, a sharp January morning, Mr. Bird writes: "We had to cut alleys through the ice to get to the Coots; N. went in front, and waving his coat on the top of the 'quant' put the Coots up, ten boats accounting for one hundred and fifty. Three which I shot, which fell upon the ice, were frozen stiff in less than half an hour! That day I noticed two or three tailless Coots amongst the slain, these probably had their tails frozen into the ice at the edge of a 'wake,' and when suddenly made to rise, pulled the feathers out. The broad was not entirely frozen over, and all Coots shot were in capital condition." But it is not only in hard weather that Coots become tame, for on some of our preserved waters they pay little regard to a boat, and in a London park I have had a wild Coot come within two paces of me for a piece of bread. I have tried them in confinement, but have not found them suitable for a small enclosure.

How long these Coot battues have been in existence Mr. Bird is unable to ascertain, but certainly as long as any of the present marshmen in his district can remember. Lubbock (1845) says nothing about it, but Mr. Stevenson speaks of it as being an old custom. I have already referred to his description (B. of Norf. vol. ii. p. 431), and the only other writer who has descanted on the pleasures of a Hickling Coot-shoot is Mr. P. H. Emerson, who has written an amusing narrative of what he saw in his 'Birds,

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Beasts, and Fishes of the Norfolk Broadland.' In the late Mr. E. T. Booth's time (1869—75) the pastime had degenerated into a somewhat disorderly mêlée, but he has also left his impressions in his Catalogue and 'Rough Notes."

At the mouth of the Rhone, Coot-battues have been for many years quite an institution, and are carried out in very scientific style. Among French writers who have described them are Alexander Dumas, Louis de Dax, Dr. J. B. Jaubert, and A. Pellicot. I am not aware of any English ornithologist having witnessed the innumerable legions of Coots which are said to be then met with, though many have looked at the Etang de Berre from the railway, and Lord Lilford describes the putting up of printed notices in towns and villages, and was himself present at a small battue in Corsica, when the rocketting Coots severely tried his skill as a marksman.

Before quitting the subject, I should like to relate my experiences of the taking of Coots on the great lakes of Lower Egypt, where they were a staple article of food when I was there, selling on Lake Menzaleh for a shilling a-piece. The method of circumventing them is most ingenious, but requires great circumspection and skill on the part of the operators.

Having silently poled a flat-bottomed boat to within a few hundred yards of where the distant "muttering" proclaims the presence of the quarry, a man puts on a black skull-cap, and naked, except for that, wades into the water, taking with him a light casting-net wound round his arm, immersing himself up to the mouth as he gets nearer to the flock of Coots, which cease feeding at midnight, and after that are easiest of approach. The Coots think the approaching scull-cap is one of themselves, and do not discover the deception until the man springs up and the cast is made, when three or four, or more, are taken. The net has no rope of attachment, and is very small and light, but the rapidity with which it is thrown, the dexterity with which it is made to spread out, and the distance to which it can be hurled—twenty to thirty feet—are indeed great. The shallowness of the water in those parts where the Coots generally feed must add greatly to the man's difficulties, necessitating his advancing in a crouching attitude, and yet without disturbance of the surface of the water. This method could only be feasible in a warm country like Egypt.

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XXI.

MISCELLANEOUS NOTES AND OBSERVATIONS.

MACROGASTER ARUNDINIS IN NORFOLK.—I have the pleasure of recording the capture at light, of one specimen of this interesting species on the 7th ult., near Horsey Mere. The Moth occurs in small numbers in the Cambridgeshire Fens, and in 1873 about a dozen eggs were introduced into Norfolk in an aldercar at Ranworth. In 1878 two specimens were taken within fifty yards of the same spot, and it was naturally concluded that these were the outcome or descendants of the ova. It is not known exactly how long the larva takes to feed up, but it is certainly more than one year, probably from two to three. Since that time no more have been taken, though the neighbourhood has been worked almost every season. The present capture, in a spot many miles distant, and without continuous communication of suitable ground, presents a curious problem. It seems incredible that the progeny of the original introduction, having disappeared from Ranworth, should have turned up at Potter Heigham; it being contrary to all experience that Moths should shift their locality otherwise than by increasing in numbers, and occupying the intervening districts. When the Horsey and Hickling Fens have been better worked, we shall be more in a position to judge; but, at present, it seems only reasonable to conclude that *arundinis* is to be reckoned as an indigenous Norfolk resident, though probably lingering in very small numbers.

I may also allude to one county speciality, *Nonagria brevilinea*, which has been this year somewhat more plentiful than usual. The species was discovered at Ranworth in 1864, and a second specimen taken at the same place by Mr. Barrett and myself seven years later. During the next few years it was taken very sparingly at Ranworth and Horning. The first capture in any quantity was in1878, by Mr. Fletcher, and since then it has occurred in numbers fluctuating, but on the whole increasing all over the continuous stretch of fens from Wroxham to South Walsham. As long ago as 1882 I found it at Barton, and it is now not very scarce there.

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This season it occurred in the Hickling Fens. This species seem decidedly on the increase, which is the more interesting, as it is abundantly distinct both in form and life history, and until a year or two ago was unknown, save in Norfolk. It is now known to occur sparingly in the Fens of Belgium.—F. D. WHEELER, LL.D.

MOLORCHUS MINOR.—Captured at Narborough, June 4th, 1900. A Longicorn Beetle not previously recorded from Norfolk.—H. J. THOULESS.

NOTES ON ROTIFERA, ETC., FROM NEIGHBOURHOOD OF YARMOUTH. During July and August I made almost daily visits to the ditches, etc., within a radius of five miles of Yarmouth, and occasional runs to Ormesby Broad. In those on the west side of Caister Road, and very close to Yarmouth, I found the water very brackish and microscopic life plentiful. Amongst numerous specimens taken from these ditches were: *Brachionus pala*, *B. mülleri*, *B. dorcas*, *Dinocharis*, *Diaschiza*, *Euchlanis*, *Salpina*, *Anurea cochlearis*, and other species.

Ditches on east side (fresh):—*Floscularia ornata*, *Pterodina*, *Notommata*, *Melicerta*, &c.

Ditches at Caister:—*Hydatina senta* (very profuse).

Ormesby Broad:—*Asplanchna brightwellii*, *Conochilus volvox*, *Eretmia* (?), *Northolca*, *longispina*, *N. scapha*, *Polyarthra platyptera*, *Pompholyx sulcata*, *Synchæta pectinata*, *S. tremula*, *Triarthra breviseta*, &c.

Having made a special search for *Volvox globator* all the summer, I had almost given up in despair, when one morning, at the beginning of August, I found it in good condition, and in fair quantity in a ditch running from Caister Road to the North Denes. Next day I found it in larger numbers in another ditch, having no drainage or otherwise connected with the aforesaid ditch, the ditch in question being parallel with the Caister Road, but found none in the adjoining ditch. Shortly after I found it again on the Southtown marshes in three distinct ditches, each apparently separate from the other. In two ditches it was but sparsely found, but in the third it swarmed almost sufficiently to colour the water. I used the bottle-net in all cases, and found it work splendidly. With regard to the larger specimens of pond-life, I found everything from *Dytiscus marginalis* down to various species of the red-water mite.

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It is worthy of mention that in the ditch on the *west* side of Caister Road the microscopic life appeared to change from week to week; certain forms being abundant one week, and absolutely missing the next. My experience is that wind drives most rotifers to the bottom, or, it may be, destroys them.—H. E. Hurrell.

Breeding of the Curlew in Norfolk.—In the volume of the 'Zoologist' for 1889, p. 306, Mr. Gurney mentions, on the authority of Mr. W. E. Baker, the interesting fact that a Curlew was believed to have bred on the Sandringham Estate. As on a previous occasion I had been greatly disappointed, on investigating a similar report of the nesting of this bird in another part of the county, to find that the eggs taken were those of the Stone Curlew, I thought it best to endeavour to substantiate Mr. Baker's belief before using the information for another purpose, and am happy to be able to confirm that gentleman's statement, and to give some additional particulars of the event.

On writing to my friend Mr. Kingston Rudd, who holds an official position on the estate and resides at Wolferton, asking him to interview Salmon, the keeper named, and suggesting certain questions he should put to him, Mr. Rudd replied that Salmon was still on the Prince's estate, and that he perfectly remembered the Long-billed Curlew, a bird quite familiar to him, nesting on the Dersingham or Wolferton Fen (it is merely a question of boundary), quite close to where he was rearing his Pheasants, and that he had abundant opportunities of observing it, especially when the male bird flew off to the sea (not far distant) every night. He saw the nest and *four* eggs, his description of which answered to those of the Curlew, and states that the bird hatched off and reared her young. Salmon further states that he found another nest with eggs in about the same place the next year (1890), but has not seen the birds there since. Mr. Rudd adds that Curlews, which are plentiful in the neighbourhood of Wolferton, are well known to the keepers, and that he does not for a moment doubt the man's truthfulness. As this is the first authentic instance of this bird having been known to nest in Norfolk, and as it adds one more species to the list of those which have done so, I think it is desirable that it should be recorded in our 'Transactions.'—T. Southwell.

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3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.

4. The record of facts and traditions connected with the habits, distribution, and former abundance or otherwise of animals and plants which have become extinct in the County; and the use of all legitimate means to prevent the extermination of existing species, more especially those known to be diminishing in numbers.

5. The publication of Papers on Natural History, contributed to the Society, especially such as relate to the County of Norfolk.

6. The facilitating a friendly intercourse between local Naturalists, by means of Meetings for the reading and discussion of papers and for the exhibition of specimens, supplemented by Field-meetings and Excursions, with a view to extend the study of Natural Science on a sound and systematic basis.

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TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY;

Presented to the Members for

1901—1902.

VOL. VII.—PART III.

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1902.

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Year ending March, 1902.

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To Subscriptions:	£	s.	d.
1 for 1897—98	0	5	0
1 ,, 1898—99	0	5	0
2 ,, 1899—1900	0	10	0
10 ,, 1900—1	2	10	0
171 ,, 1901—2	42	15	0
3 ,, 1902—3	0	15	0
	47	0	0
,, Additional payments	0	12	0
,, Sale of *Transactions*	1	14	2
,, Donation, Mr. J. H. Gurney	10	10	0
,, Transferred from Life Membership Fund	20	0	0
	£93	6	9

Cr.	£	s.	d.
By Fletcher and Son, Limited, *Transactions*, 1900—1901	52	6	0
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,, Postage and Carriage	5	16	6
,, Insurance	0	9	0
,, Year Book of Societies	0	6	1
,, Breydon Wild Bird Protection Society	1	1	0
,, Norfolk and Norwich Library	1	1	0
,, Bookbinding	5	2	0
,, Doorkeeper at Museum	1	0	0
,, Assistant Secretary's Salary	5	0	0
,, Subscription returned, paid in error	0	5	0
,, Balance at Messrs. Barclay's Bank	14	12	2
	£93	6	9

LIFE MEMBERSHIP FUND.

	£	s.	d.
To Balance in Norfolk and Norwich Savings Bank ...	100	16	8
,, 1 Composition for Life Membership	4	0	0
,, Interest to November 20th, 1901	2	11	6
	£107	8	2

	£	s.	d.
By Transferred to General Account	20	0	0
,, Balance in Norfolk and Norwich Savings Bank. ...	87	8	2
	£107	8	2

Norwich, 24*th March*, 1902.

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STEPHEN WM. UTTING, *Auditor.*

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List of the Publications received by the Society as Donations or Exchanges from March, 1901.

ALTERNATION of Generations, by J. J. Steenstrup. Ray Society. London, 1845. *From Mr. Charles Williams.*

ANDERSONIAN Naturalists' Society Annals. Part 2. Vol. ii. Glasgow, 1900. *From the Society.*

ANIMALS recently Extinct, or threatened with extermination, as represented in the Collections of U. S. Natl. Museum. F. R. Lucas, 1888-89. *From Professor Newton.*

AMERICAN Ornithologists' Union. A Seven Years' Retrospect. T. A. Allen. New York, 1891. *From Col. Feilden.*

AQUILA (A.). Hungarian Ornithological Journal, in Parts. 1894—95—96, 1898, No. 4, 1899. Budapest. *From Professor Newton.*

AUSTRALIAN Birds, Catalogue of the, in Australian Museum, Sydney, N. S. W. Parts 1 and 2. *From Professor Newton.*

BARROW Naturalists' Field Club. Annual Report. Vol. xv. Barrow-in-Furness, 1902. *From the Club.*

BATH Natural History and Antiquarian Field Club, Proceedings of the. Vol. ix. no. 4. 1901. *From the Club.*

BIRDS, Classification of, Supplement by Henry Seebohm. London, 1895. *From Col. Feilden.*

BIRDS' Eggs, List of, belonging to J. J. Dalgleish, June, 1898. *From Col. Feilden, C.M.Z.S.*

BIRDS, Hand List of Genera and Species. Vol. iii., by R. Bowdler Sharpe, LL.D. London, 1901. *From the Director (British Museum).*

BIRDS of Central New York. Revised List. F. R. Rathbun. Auburn, N. Y., 1879. *From Col. Feilden.*

BIRDS, The Architecture of. Rev. Jas. Rennie, A.M. London. *From Col. Feilden.*

BLASTOIDEA, List of Genera and Species in the British Museum (Nat. History), 1899. *From the Director (British Museum).*

BOTANICAL Exchange Club, Watson. Fifteenth Annual Report, 1899. *From Mr. A. Bennett, F.L.S.*

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BOTANY. Norfolk Notes. Reprinted from Journal of Botany, by Rev. E. F. Linton, M.A. 3 Pamphlets. *From the Author.*

BOURNEMOUTH, Flora of, including the Isle of Purbeck, by Rev. E. F. Linton, M.A. *From the Author.*

BRITISH Association, Report of Glasgow Meeting, 1901. *From the Association.*

——— Report of Corresponding Societies' Committee. *From the Association.*

BRITISH Lepidoptera. Vol. vii. Heterocera (Geometrina). C. G. Barrett, F.E.S. London, 1901. *From the Author.*

BRITISH Birds, Manual of. W. Macgillivray, A.M., etc. London, 1846. *From Col. Feilden.*

CASTLE Museum Committee, Report of to The Town Council. Norwich, 1901.

CHIROPTERES, Note son une Recolte de. H. G. de Kerville. Rouen, 1901. *From Mr. J. H. Gurney, F.Z.S.*

COLEOPTERES, L' Accouplement des, Extrait du Bulletin, Soc. Entom. de France, 1900—1901. Par. H. G. de Kerville. *From Mr. J. H. Gurney, F.Z.S.*

CROYDON Microscopical and Natural History Club, Proceedings of. 1901. *From the Club.*

DRAFT of Schęme for Preserving, etc., the Large Game and Wild Animals in the Transvaal. London, May, 1900. *From Col. Feilden.*

DREISSENSIA polymorpha, by W. Wells Bladen. N. Staff. Field Club. *From the Author.*

EALING Natural Science and Microscopical Society. Report 1900—01. *From the Society.*

ECTODERM OF THE AMPHIBIAN EMBRYO, Notes on the Ciliation of the. Reprinted from Quarterly Journal Microscopical Science. R. Assheton, M.A. *From Professor Newton.*

EDINBURGH Geological Society Transactions. Vol. viii. Part 1. Edinburgh, 1901. *From the Society.*

EI der Vögel und der Reptilien, Ueber das. Dr. F. J. C. Mayer. Dresden, 1865. *From Professor Newton.*

EMBRYOLOGY OF Monotremata and Marsupialia. Part 1. Phil. Transactions Royal Society. London, 1887. W. H. Cadwell, M.A. *From Professor Newton.*

ENGLISH WORDS, A Collection of, not generally used, etc. . . . With Catalogue of English Birds and Fishes, etc., by John Ray, F.R.S. London, 1674. *From Mr. T. Southwell, F.Z.S.*

ENTOZOA (From the Fauna Hawaiiensis, Vol. ii. Part 4). A. E. Shipley, M.A. *From Professor Newton.*

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ESSAYS upon Heredity and Kindred Biological Problems, by Dr. August Weismann. Authorised translation by Poulton, Schönland, and Shipley. Oxford, 1889. *From Professor Newton.*

EXE Estuary, The Fauna of the, by E. J. Allen, D.Sc., and R. A. Todd, B.Sc. Reprint from Journal of the Marine Biological Association, Jan. 1902. *From Mr. R. A. Todd, B.Sc.*

FIELD Columbian Museum Publications, 45, 52, 54.
45. Synopsis of Mammals in N. American and adjacent Seas.
52. Annual Report.
54. List of Mammals obtained by Collector for Museum in Provinces of New Brunswick and Quebec, Canada.
From Mr. J. H. Gurney, F.Z.S.

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ADDRESS.

Read by the President, MR. W. H. BIDWELL, *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-third Annual Meeting, held at the Norwich Castle-Museum, March 25th, 1902.*

LADIES AND GENTLEMEN—It now becomes my duty to pass in review the work of another year, a year which we may consider a prosperous one for our Society. It is true we have to lament the loss of some old and valued friends, but we have gained new members and we now number 265. Those removed by death are:—Archdeacon W. Pelham Burn, Messrs. D. C. Burlingham, John Young, and E. L. Birkbeck, short notices of whom will be found in our 'Transactions.'

Our meetings have been well attended, and many of them have been of a very interesting character. Most of the papers contributed will be printed in our 'Transactions.' I will not therefore trouble you with a list of them, but will mention two important exceptions.

On the 20th May, Dr. Gerald Leighton addressed us on British Serpents, especially with regard to their distribution, illustrating his lecture by exhibiting many specimens obtained by him during a short stay in East Norfolk. At our January meeting, Mr. F. W. Harmer read "A Geological Sketch of the History of Broadland." Unfortunately, Mr. Harmer had promised this paper for publication elsewhere. Much useful discussion followed, and we were glad of the opportunity for congratulating the author on the honour of receiving the Murchison Medal, recently awarded him by the Council of the Geological Society.

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Departing from our usual custom, we made arrangements in December for an Illustrated Lecture, entitled, "Pictures from the White Nile," in which Mr. E. N. Buxton kindly gave us an account of his recent journey 400 miles beyond Khartoum; and his descriptions of the country, the natives, the fauna and flora, and his adventures with big game, gained increased interest from the numerous photographs thrown on the screen.

Our Society was represented at the meeting of the British Association at Glasgow, as will be seen by the report of the Corresponding Societies' Committee, and Mr. F. D. Longe, who was our delegate, narrated to us his experience of the meetings. The public-spirited inauguration of a Freshwater Biological Station at Catfield, by Mr. Eustace Gurney, must not pass without notice; it is the first attempt of the kind made in England, though several are in working order on the Continent, and in America. Mr. Gurney has had a house constructed on the edge of Sutton Broad, with accommodation for four students; it contains a well-lighted laboratory, fitted with the necessary appliances for the study of the animal and plant life of the district. Mr. Gurney had the advantage of acquiring manipulative skill at the Naples Biological Station; and his brother, Mr. Robert Gurney, who is engaged in like work at Plymouth, kindly sends us yearly the Journal of the Marine Biological Association. We have to thank other friends for valuable additions to our library, especially Professor Newton, Mr. J. H. Gurney, and the Rev. E. N. Bloomfield.

Activity in bookbinding during the year made the need for another book-case increasingly felt, and this has now happily been supplied, Mr. J. H. Gurney having generously paid half the cost of a new case, which by permission of the Committee of the Norfolk and Norwich Library has been erected in that Institution, near those which are already filled with our books.

One of your Presidents, the late Sir Francis Boileau, spoke to us, on one occasion, of the importance of supplementing our evening meetings by excursions in the summer months, for such gatherings he considered to be a sign of the vitality of our Society, and very desirable opportunities for friendly intercourse with our country

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members. Though we took no long excursion last summer, yet the Committee made arrangements for four afternoon trips. Those who joined the first of these, took train to Swainsthorpe, whence they walked to Dunston; after visiting the gardens there they crossed the park, and proceeded to Upper Stoke; here the leader of our excursion had kindly provided tea in his garden, and after a rest the return was made by the field-path to Trowse.

In June an excursion was made to Wroxham Broad, where the entomologists of the party met with some success. In July our field meeting was at Felthorpe, where botanists could enjoy a stroll through the bog and over the heath at Drayton Druery. The weather was perfect for such an excursion, and especially agreeable for tea in one of the glades of the wood.

Our last excursion was in August, to Stratton Strawless, where we were most kindly entertained by Mr. W. J. Birkbeck, after an afternoon pleasantly spent in viewing the home of Robert Marsham, with its historic trees. I am sure that all who enjoyed these outings feel under great obligation to the Secretary of the Excursion Committee, for his forethought and trouble to make them successful.

Knowledge pleasantly gained on these expeditions, must prove useful to many members, not only helping them in their own particular line of study, but also increasing their acquaintance with other branches of Natural Science, thus rendering them capable of more fully enjoying the sights and sounds and scents of the country, and enabling them to gain fresh happiness, from

> "Every bird that sings,
> From every flower that studs the elastic sod,
> From every breath the radiant summer brings."

The fragrance of wayside flowers and woodland odours adds much to the pleasure of our country rambles; and I would ask your attention for a short time to a few thoughts suggested by these floral scents, and to the consideration of their nature and uses.

The first subject for our consideration may well be the grouping of floral scents, which until lately has not been attempted on any scientific basis; botanists having been contented with tracing resemblances between the odours of flowers, and giving to a distinct

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odour the name of some prominent flower by which it was given out. But lately an attempt has been made in 'The Natural History of Plants,' by Anton Kerner von Marilaun, edited by Prof. Oliver, to classify floral scents according to their chemical properties; which however the writer says must be regarded only as a preliminary outline.

For the purpose of distinguishing such scents, they are divided into five groups, viz. : the indoloid, aminoid, benzoloid, paraffinoid, and terpenoid scents. In the first group, the *indoloid* scents are those volatile substances which arise from the decomposition of albuminous compounds. These scents resemble that of decaying animal matter, and attract flesh-eating Beetles and Flies; the enticement of this smell of putrefaction being often aided by colouring which resembles flesh or rotting fruit. Among the plants which emit this indoloid scent are Aristolochias, Stapelias, and Arums, and as showing the great distance from which insects are drawn by such odours, it may be mentioned that in a single spathe of *Dracunculus vulgaris* there were found 250 Carrion Beetles belonging to eleven different species. We are not therefore surprised to read that emanations from this Arum are extremely inconvenient, producing giddiness, headache, and vomiting.

Under the name of *aminoid* scents are comprised substances which diffuse into the air, and have an amine as their foundation. These give to the Hawthorn its scent, as well as to the Chestnut, Evening Primrose, and Flowering Ash.

The third group, that of the *benzoloid* scents, is composed of such as are formed from the so-called aromatic bodies; they are compounds with a benzole nucleus, in which the hydrogen atoms of the benzole are replaced by alcohols and acid radicals. These scents are found in the flowers of Pinks, Heliotrope, Lilac, Mignonette, and Honeysuckle, and many of them in flowers of widely differing genera; thus we have the violet scent in the Stocks, the Clove scent in the Narcissus and in some Orchids, and the Vanilla scent in the Heliotrope, *Petasites fragrans*, *Nigritella* and *Linnæa borealis*. It is worthy of note, that many of the flowers which have intermittent scents are to be found in this group, *e.g.*, the Catchflies, which emit

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a scent of Hyacinths at night, the Honeysuckle, the Dame's Violet, and many of the Stocks.

The *paraffins* give their name to a group of scents among which the Rose scent is the chief in importance, and in which are included the honey scents, as those of the blossoms of Cherry, Plum, and Clover; the honey scent is found in combination with many in the preceding group, hence a great variety of odours. Among the Roses we have many different perfumes, and though there is no scent of tea in the so-called Tea Roses, as has been pointed out by the Rev. A. Foster-Melliar in the Book of the Rose, yet there are to be found the Clove scent in Safrano, that of the Raspberry in Marechal Niel, of the Apricot in the Macartney Rose, and Mignonette in the Dog Rose, while a few Roses are absolutely scentless. *Rosa centifolia*, from which, with its descendants, attar of Roses is chiefly made, may be considered to possess the typical rose scent.

The last group consists of scents produced from ethereal oils, called terpenes, which scents are more often found in the stem and foliage than in the flowers. Lavender, Thyme, and Citron may be taken as examples. It is to be hoped that, in the near future, more attention may be given to this classification of vegetable perfumes.

Another subject for enquiry is the fluctuating character of many of these scents. Why are some plants scentless at certain hours of the day and odoriferous at others? The advantages to the plant of such an arrangement are patent, the periods of fragrance coinciding with the hours at which those insects are on the wing whose visits benefit the plants. Thus Acacias, which are visited by Bees, are scentless in the evening; while flowers which attract crepuscular Moths are inodorous in the day-time; for the visits of insects which do not assist in the transference of pollen are disadvantageous to the plant.

Very little appears to be known of the manner in which this intermittent emission of scent is brought about. Alternations of gentle rain with intervals of sunshine favour the promulgation of odours, the secretion of which is assisted by heat, and the increase or diminution of heat may often determine these periods of fragrance; an increase helping to volatilize scent, and a decrease preventing its

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too rapid dissipation; moreover, a change of temperature may, by expansion, or contraction, exert a pressure on the vesicles which contain the volatile scent.

The fragrance of flowers is, however, affected by light as well as by heat. We have an illustration of this in an article in the *Journal de Pharmacie*, 1827, on the effect of the sun's rays upon the flowers of *Cacalea septentrionalis:* "When the sun shines upon the flowers of this plant they are odoriferous, but when the sun's rays are interrupted by artificial means—that is, by interposing the hand—their odour quickly disappears, but their fragrance as quickly returns when the shade is removed." Many plants are so sealed by their closing petals that it is easy to see that perfume cannot escape until they re-open; though with others the scent is cut off without any apparent change in the flower; but it may be that with such there is a slight change in the position of the petals. The Rose is one of the few flowers which have scented petals, hence its use in making *pot pourri;* it possesses also the only scent on which, when extracted, direct sunshine has no deleterious effect.

The time at which flowers re-open and re-commence shedding their perfume often agrees with the time of day at which the buds first opened; in fact, there are many cases in which the clock rather than the barometer appears to regulate the expulsion of odours. The behaviour of one of the night-blooming *Cactaceæ* often quoted, may be referred to as bearing on this subject. The flowers are fragrant only at intervals, giving out puffs of odour every half-hour, from eight in the evening till midnight, the first puff of odour being accompanied by a rapid movement of the calyx.

We may next enquire as to the advantages gained by the plants from their perfumes. The chief benefit is the allurement of insects, for the transference of pollen from the stamens of one flower to the pistil of another of the same species.

While some plants arrest the attention of insects by their brilliant colours, others attract them by their sweet odours, and in many plants both influences are at work, as in the Nicotiana of our gardens, whose conspicuous white flowers, after being furled during the sunlit hours of day expand in the evening, and at the same

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time emit a beautiful perfume. If the colours of flowers have been developed by the selection exercised by insects, this is doubtless also the case with the odours.

Insects which visit plants and thus distribute pollen, belong mostly to the families Hymenoptera, Lepidoptera, and Diptera; but many flowers are visited by insects for shelter only, especially those which are bell-shaped, or those which are fluffy. Fertilization is sometimes caused by the movements of the larvæ, and not by the perfect insects. Thus Blowflies deposit their eggs in the carrion flowers, and the Maggots in searching for food press the pollen masses downward to the stigma.

The importance of the parts played respectively by the senses of sight and smell, in luring insects to melliferous flowers, has been much in dispute. Some naturalists insist that sight has the greater influence. Lord Avebury has recorded experiments which he made to obtain evidence of the power of Bees to distinguish colours. He placed slips of glass with honey on papers of various colours, and when they had made a few visits he found that if the papers were transposed the Bees followed the colours.

An incident narrated by a well-known naturalist bears on this question. He was walking in Newgate Street when his attention was caught by a White Butterfly, and as he was surprised to see the insect in such a locality, he watched it carefully, and observed that it was flying round a lady's hat which was trimmed with many artificial flowers, and it hovered for some time over this scentless bouquet.

On the other hand, Professor Plateau of Ghent, after the labour of most careful observations, the results of which he has communicated to the *Société Entomologique de Belgique* regards the sense of smell as the chief agent in guiding insects to the flowers, and he doubts whether their supposed choice of colours really exists. Professor Plateau removed the coloured corollas from widely different flowers, and found that they were visited by Bees and Butterflies just as freely as those which had not been so treated, and he writes in answer to a letter from myself, "It is thus very natural to suppose that insects are attracted to the flowers by another sense

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than sight, and that that sense would very probably be smell;" but he adds, "I insist on this fact, that I have never said that insects are not drawn towards flowers except by the sense of smell only."

Mr. F. W. L. Sladen has recently communicated to the 'British Bee Journal' an account of experiments which led to his discovery of the scent-producing organ of the Bee, which is contained in the membrane connecting two of the body segments of the insect. He considers that scent is produced from this membrane for purposes of allurement, and that the rapid movement of the wings when Bees are humming, is not to produce sound so much as to distribute scent. When Bees hum on reaching the entrance to the hive, they arouse others, which have settled down tired in the grass, these latter, but for this attraction, would be unable to find the portal, and thus perish from cold. If Mr. Sladen be right in asserting that scent plays an important part in this attraction, and that this adds evidence to the belief that Bees can distinguish between smells; it also adds to the probability that Bees, being accustomed to guidance by scent, are similarly guided by the perfume of the flowers in seeking honey.

We must not judge of the choice of insects for certain scents by considering what is most pleasing to ourselves; some flowers evidently attract by their odour, which seem to us to possess none, while insects are drawn by some which have a disagreeable smell though they are rich in honey; thus, as far as insects are concerned, the Violet in vain sheds its perfume on the air, while Ragwort and French Marigold with their unpleasant odours have always a crowd of visitors.

It has been observed that Bees usually visit plants of the same species as long as they can: this is perhaps to save themselves trouble in collecting nectar, but it may be to avoid work in sorting pollen. Maeterlinck, in 'The Life of the Bee,' describes a day's work of the occupants of the hive, and referring to this, says, "Those who yesterday were absorbing nectar from the corollas, will to-day repose their tongues and the glands of their sac, and gather red pollen from the Mignonette, and yellow pollen from the Lilies, for never shall you see a Bee collecting or mixing pollen of a different

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colour or species, and indeed one of the chief pre-occupations of the hive, is the methodical bestowal of their pollens in their store-rooms, in strict accordance with their origin and colour."

Where then must we seek the guide which directs the flight of the Bee on her second visit to the flowers? Is it the conspicuous corolla or the pollen covered anthers? or is it the remembrance of the odours only? by which she can

> "With conscious truth retrace the mazy clue
> Of varied scents which charmed her as she flew."

If we watch the Bees in our gardens flying from flower to flower, apparently without method or choice, we shall perhaps wonder whether too much has not been made of this "flower fidelity."

What are other benefits that the plants derive from odours which they emit? They gain protection from herbivorous animals; in some cases the smell renders the leaves distasteful, and in others the scent gives warning that the plant, though not unpleasant, is harmful: this is the case with the Thorn-Apple, Hemlock, and Deadly Nightshade. The warning to avoid these seems to be given by the olfactory nerve. The scent of the stem is also a protection against the depredations of larvæ, as with many of the Coniferæ, and with the Sweet Flag, which we cannot believe to have been developed from a Common Flag into an odorate Calamus for the benefit of Abbots and Aldermen, who loved to strew their halls with its fragrant leaves.

The researches of Professor Tyndall made known to us the action of odours on radiant heat, and he published a table showing the relative potency of various perfumes as intercepters of radiation; from this it appears that the odour of oil of Cloves exercises about thirty times the action of the air, of Lavender sixty times, and that of Spikenard up to three hundred and fifty times. This discovery suggested another advantage to be derived by plants from their perfumes; in hot and dry countries the secretion of strong scented ethereal oils, surrounds the plant with an invisible though most efficient shield against the baneful effects of radiant heat, and we observe that Spikenard which comes from a country where such protection is much needed, is one of the most powerful absorbents

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of heat. Fruity scents benefit some plants by attracting from a distance insects and animals which help the distribution of small seeds which are imbedded in fleshy fruits, like the Fig and the Strawberry. Some fungoid scents are of this kind, as that of the *Cantharellus cibarius* with its odour of Apricots, but most of them are of a starchy or fœtid character.

But when we have considered all these aids to plants, there remain many cases in which it is difficult to perceive how the plants are benefited by their odours, for instance the scented ferns and the grasses which are odoriferous only when dying. We are conscious of something beyond all this, and would fain fall back on the ancient belief that the green herb was made for the service of man, and that part of that service is rendered by perfumes. How rendered we will next consider.

Some scents are useful for their medicinal virtues, as in the Hop pillow, a specific for insomnia. The narcotic scents of Poppy heads and Camomile are well known; and the vapour of Hellebore has a purgative effect. In times past, plants with scented leaves and stems were much used as disinfectants, for which they were put in coffins before burial, and sprigs of Rue were placed near the judges to ward off jail fever; again the smell of camphor has long been considered a prophylactic. If not germicides, such scents are certainly insecticides; and pleasant odours often keep off noisome pests.

It is chiefly in nervous complaints that the benefits of vegetable scents are noticeable. Pliny speaks of the curative properties of perfumes in such cases, and there can be no doubt that a nice smell improves the temper. Thus Gerard says of the Violet, "the mind conceiveth a certain pleasure and recreation by smelling and handling those most odoriferous flowers;" and the scent of Borage leaves is reviving and exhilarating, hence their use in claret cup.

We appreciate the flavour of much that we eat and drink by the olfactory nerve alone, for we are often smelling when we think we are tasting. The odours from some resins are beneficial, and the fortune of a noted watering-place was made by the smell of its Pine woods. May the time be near when physicians shall prescribe

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half-an-hour in a perfumed atmosphere, rather than a dose of nauseous medicine!

Something might be said about perfumes and morals; the cloying odours of Eastern lands induce a dreamy sensuousness, while the refreshing fragrance of wild Thyme braces men for healthy action. The consumption of the wholesome but malodorous Onion is a question of manners rather than morals, though Ruskin says that this rank scent has been really among the most powerful means of degrading peasant life. Olfaction warns us against dangers which often accompany bad smells, and we shall certainly be more ready to detect these if we educate this sense, and accustom ourselves to the enjoyment of smells that are good. The poet asks,

"Can ye take off the sweetness from the flower?"

In reply we can point to the important industry which finds employment for thousands of persons, in taking off the perfume from the Rose, and in collecting Violets, Jasmine, Mignonette, Geraniums, and other flowers, from which extracts are made. For this purpose, one Scent Manufactory at Grasse alone consumes in one harvest, nearly 600,000 lbs. of Roses, and so powerful is the perfume from the Orange flowers that the gatherers often fall from the ladders overcome by it.

There are three commercial processes in use for procuring the scented extracts of flowers: 1, Distillation, by which method Attar of Roses is made; 2, Maceration, which consists in newly picked flowers being thrown into hot fat or oil, which is afterwards strained from them; and 3, Enfleurage, by which exquisite essences are procured. In this last process a number of shallow frames, each with a layer of fat spread upon it, are piled one above the other; fresh blossoms are periodically scattered over the fat, which by absorption finally becomes a scented pomade; this can be afterwards digested with rectified spirit, and a concentrated essence obtained.

There are many flowers which have two scents, and with some of these one scent is given off in the day-time and the other in the evening; when there is this "duality of fragrance," one perfume

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can often be got by distillation, and another, quite distinct, by maceration.

The late Dr. Piesse, in his book, 'The Art of Perfumery,' gives much interesting information about floral perfumes, and we learn from him to what an extent the skill of the perfumer enables him to imitate in his essences, scents which it would be too costly to extract from the flowers. Sweet-briar, Honeysuckle, Lily of the Valley, Sweet Pea, and Verbena, are never extracted from the flowers whose names they bear. May we not then suppose that many perfumes are compounded in Nature's laboratory by a blending, in varying proportions, of well-known odours?

There are many vegetable odours which, when concentrated, are exceedingly unpleasant to our nasal organs, though very agreeable when much diluted: thus, a whiff of Eucalyptus is like Cedar-wood, and Storax, a fragrant balsam much used in making incense, when in bulk exactly resembles the stench from Coal-tar Naphtha, but when divided has the fragrance of the Jonquille.

The only scent which is better made in England than elsewhere is Lavender; the plant has two odours, one ligneous the other floral; on account of the former we lay garments up in Lavender to keep away insects, and because of the latter we plant bushes near hives to attract insects.

Among curiosities in scents, we may note cases in which those of animals are reproduced in the vegetable world; as the smell of Mice, from which that of Hemlock is not to be distinguished, and that of the Musk Rat and Musk Deer which we find in the Musk plant, so often grown in cottage windows. The vegetable Musk is not powerful enough to be used in perfumery.

The Ancient Egyptians imported perfumed Balsams from the East in very early times, they also appreciated the scent of fresh flowers, as we learn from an illustration from a painting on a tomb at Thebes, given by Sir E. Wilkinson, where a lady is represented seated in a bath, with an attendant holding a sweet-scented flower to her nose, while others are pouring water over her. The use of perfumes became fashionable in England in the reign of Queen Elizabeth, partly through the introduction of scented gloves, the

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leather for the manufacture of which was imported already perfumed, and often strips of this leather were sold to scent linen chests, hence arose the union of the two trades, glover and perfumer; the only scented leather of to-day, Russia leather, owes its perfume to the oil of Birch, used in the tanning.

The latest triumph of the perfumer's art is the extraction of some of the choicest perfumes from coal-tar, or rather from coal-tar products, and these compounds are chemically identical with those which have been elaborated by the processes of nature in the living plant. The first of these to be discovered, "essence of mirbane," is made from benzene, and passes under the name of artificial oil of almonds, others are "new mown hay," which is now obtained, not from the sweet-scented vernal grass, but from tar; and white Heliotrope, which is made by mixing mirbane with vanillin, the latter closely resembling and to a great extent taking the place of the vanilla bean.

I will give but one further illustration of blessings brought to man by floral perfumes. There can be no doubt that the sense of smell recalls to our minds scenes of bygone years more vividly than sight or sound, and the reason for this is said to be that stimulation of the olfactory nerve "gives a massive sensation." We all acknowledge the joy which comes from happy memories, and perfumes bring back to us long forgotten incidents, and days in the distant past,

> "When nature pleased, for life itself was young."

Then indeed the evening fragrance of Honeysuckle gave a charm to country lanes, and in the morning air the heart exulted in the scent of wild Thyme on a breezy common; then all the trees of the wood rejoiced, and the flowers offered up their incense of praise.

Thus of a truth

> "The present joys of life we doubly taste
> By looking back with pleasure on the past."

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I.

EAST NORFOLK GEOLOGY—WELLS AT MUNDESLEY, NORTH WALSHAM, AND METTON.

By Clement Reid, F.R.S.

Read 24th September, 1901.

The last few years have seen the sinking of several wells, which throw light on the geology of an obscure part of East Norfolk. A short notice of two of these wells has already appeared in the 'Summary of Progress,' of the Geological Survey;* but I have now obtained further information, which enables me definitely to fix the geological date of the doubtful deposits.

The first well I have to describe is one sunk at Mundesley, for the supply of that growing watering-place. On a good many occasions, during past years, I had been asked by the local authorities how they could best obtain a good supply of water, and had recommended sinking to the chalk; but the exact depth to that rock was still doubtful, a trial-boring made by the Geological Survey not having penetrated the crag, though it was sunk to twenty-two feet below mean-tide level.† In 1898, after a trial-boring which proved chalk at ninety-seven feet, a well was sunk by Messrs. Merryweather and Sons, at a spot selected as probably sufficiently far from the sea to avoid the influx of sea-water, and yet not too far from the village, or at too high a level. The site is in the valley, near Frog's Hall, and is about seventy feet above the sea. Samples from the trial-boring were communicated to me by the well-sinkers, but were insufficient to throw much light on the

* 1898, p. 145.

† "Pliocene Deposits of Britain," p. 137, Mem. Geol. Survey.

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geology. Happening, however, to be at Mundesley on two occasions while the larger well was being sunk, I was able to obtain, from the waste, some specimens which add greatly to the interest of the section, though I have never been able to obtain any satisfactory and continuous record of the strata passed through in the shaft. Samples of the chalk and flints met with in sinking were sent to me by the foreman, who states that the sunk well reached chalk at a level considerably higher than that in the boring, though the two are close together. The highest sample of chalk is marked 89′, and a flint-bed occurred at 90′. It looks as though the boring may have hit upon a channel scoured in the chalk in Pliocene times; I cannot otherwise explain this irregularity.

The following table shows the strata met with in the trial-boring, with the addition (in square brackets) of notes of larger samples obtained by me, on the spot, during the sinking of the well :—

MUNDESLEY WELL.

		Thickness. feet.	Depth. feet.
Soil.	Loam and small stones	3	3
Contorted Drift.	Yellow loam and small stones	26	29
	Greyish chalky loam	11	40
Second Till.	Lead-coloured clay and flints	10	50
Arctic Freshwater Bed.	Flints, &c.	1	51
	Pebbly greenish sand	4	55
	[Laminated loam, full of mosses and leaves of Arctic plants] ...	? about	59
Cromer Forest-bed.	Large flint		61
	Loamy pebbly sand, [lignite and coarse gravel of flint and clay ironstone. Fragments of bone]	10	71
Chillesford Clay and Weybourn Crag.	Laminated micaceous silt, [with *Scrobicularia* and *Hydrobia ulvæ*] ...	19	90
	Gravel of flint, quartz, quartzite, ironstone, pyrites, &c.	5	95
	Gravel [fragments of *Tellina balthica*, apparently from this part of the well, were found in the spoil-heap, but no fossils were seen in the boring]	2	97

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		Thickness. feet.	Depth. feet.
Upper Chalk.	Soft chalk, usually grey-mottled, flints at 120′, 160′ (black with very thin rind), 161′ (with cavity containing mealy powder full of sponge-spicules), 190′ (imperfect spongy flint), 200′ (black with thin rind). [*Ostrea lunata*, characteristic of the highest chalk in Britain, was plentiful down to 150′] ...	103	200

The upper part of this section calls for no comment, the succession being identical with that seen in the cliff half a mile from the well. The Arctic Freshwater Bed contains numerous badly-preserved leaves of *Salix polaris;* but I could find no other flowering plant. The samples I obtained were masses of felted moss and fine mud, resembling glacier mud. Mr. H. N. Dixon, F.L.S., to whom I submitted the mosses, reports as follows:—

"The bulk of the material consisted of *Hypnum turgescens*, Schimp., which was recorded from Mundesley by Dr. Nathorst, in 1872, from the same beds, in company with *Salix polaris*. The record was a specially interesting one, as *H. turgescens* no longer occurs in the British Isles, and while it has a wide distribution throughout the northern and temperate regions of Europe and North America it is distinctly a boreal moss, occurring in Greenland, and being perhaps nowhere so abundant as in Spitzbergen.

"The present material contained fragments of two additional species of *Hypnum*, hitherto unrecorded from Britain. The first of these is *H. capillifolium*, Warnst., a moss with a distribution somewhat similar to that of *H. turgescens*, being found in scattered localities from Siberia, through Central and Northern Europe to Vancouver and other localities in the northerly regions of the American continent; it is not, however, at present recognised as so distinctly a boreal plant. A mere fragment of a stem was found, but the plant is so distinct that its identification scarcely admitted of a doubt; and the determination has been verified by Renauld, a recognised authority on the group in question.

"The second of the species mentioned above is *H. Richardsoni*, Mitt. (= *H. Breidleri*, Juratz.), also verified by Renauld. This is closely allied to *H. cordifolium*, Hedw. and *H. giganteum*, Schimp., differing (as to vegetative characters) from the former in the narrower cells more abruptly enlarged at the basal angles, and from

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the latter in the narrower nerve. The claim of *H. Richardsoni* to specific rank is, however, held by some bryologists to be rather of a doubtful nature, and the characters on which it is founded certainly leave somewhat to be desired.

"Another plant of some interest is *Hyp. polygamum*, Schimp. This occurred in considerable quantity, but always in a small and slender form, with the nerve often very feeble, and at times almost obsolete. The species is one found not rarely at the present day in Britain; but, as a rule, it is the typical and larger forms that occur here, with well marked nerve, while varietal forms such as the above are rare; on the other hand, in Spitzbergen, they appear to be frequent (*cf.* Berggren, Musci et Hepaticæ Spetsbergenses). The remaining species are all frequent forms at the present day.

"The following is a list of all the species found that were at all determinable:—

"AMBLYSTEGIUM VARIUM, Lindb.
HYPNUM POLYGAMUM, Schimp.
H. SENDTNERI, Schimp. } One or other, perhaps both of
H. WILSONI, Schimp. } these species or varieties of the same species.
H. CAPILLIFOLIUM, Warnst.
H. FLUITANS, L.
H. REVOLVENS, Swartz.
H. INTERMEDIUM, Lindb.
H. RICHARDSONI, Mitt.
H. TURGESCENS, Schimp.
PLEUROCARPUS SETA and PERICHÆTIUM, indeterminable."

Though these masses of felted moss were obtained from the spoil-heap and the well-sinkers had not recorded their occurrence, yet there is no real doubt as to the order of the strata, for at the time of the visit the well had only been sunk a few feet lower, and was in the coarse gravel of the Cromer Forest-bed. The arctic plants occur somewhere between fifty-five and sixty-one feet, and from the quantity of material thrown out, the bed must have been at least two feet thick.

The Cromer Forest-bed calls for no remark; it is identical with that exposed on the foreshore at Mundesley, and has about the same

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thickness. No trace of the freshwater clay with temperate plants was observed in the spoil heap; but this bed at Mundesley is quite local, and never more than a foot in thickness.

The Chillesford Clay (seen during the next visit) was like that bored into on the foreshore to a depth of twenty-two feet in 1892 (all Pliocene deposits tend to thicken towards the North Sea). The occurrence in it of *Scrobicularia piperata* and *Hydrobia ulvæ* is sufficient to prove its estuarine origin; but the shells are extremely rotten, and I could find no foraminifera or other microscopic organisms. The gravel below is obviously the equivalent of the gravelly Crag of Weybourn and Runton, here more estuarine, though perhaps deposited in deeper water. Fragments of thin-shelled *Tellina balthica* were fairly abundant in the spoil-heap where the material from immediately above the Chalk had been placed; but I could find no other of the characteristic Weybourn Crag species, though they are known to occur at Trimingham and North Walsham.

The character of the Chalk met with in the Mundesley Well settles a doubtful point in Norfolk geology. It has long been known that the Chalk of Trimingham was probably the highest in England, and recent work has shown that it belongs to a division (zone of *Ostrea lunata* and *Thecidium vermiculare*), unknown elsewhere in this country, and containing fossils peculiar to high beds on the Continent. A doubt, however, has arisen as to the Trimingham Chalk; for it is everywhere disturbed and raised by glacial action, and in several places boulder clay can be seen to pass beneath it. This suggests that the whole mass may be nothing but an enormous boulder transported from some other region. In the Mundesley Well, however, there is no such doubt, for undisturbed Chalk is there overlain by various stratified preglacial deposits. It is interesting therefore to find that this Chalk is like that of Trimingham, and contains, in abundance, the same peculiar oyster for the first sixty-one feet at any rate, and the same peculiar cavernous flints throughout. Unfortunately, the specimens of Chalk saved for me contained no other fossils, and I found, on my last visit, that all the rest of the Chalk had been carted away and placed under the floor of a barn—where, perhaps, it may be got at by some geologist in the future.

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The next Well to be described is one sunk in 1898, for the supply of North Walsham, and this also was completely successful. An excellent record of this Well was kept by Messrs. Tilley and Sons, and I have also to thank the engineer, Mr. J. C. Mellis, for full particulars, and for sending me a large box of the shelly Crag. This yielded so large a series of fossils as to leave no doubt as to its belonging to the Weybourn Crag, which here also extends down to the Chalk. The section of the boring is as follows :—

NORTH WALSHAM WELL

(surface 143 feet above Ordnance Datum).

		Thickness. feet.	Depth. feet.
	1. Soil	1	1
Glacial Gravel.	2. Rich reddish-yellow gravel and sand ...	5½	6½
	3. Boulder flints and rough flinty gravel...	1½	8
	4. Light buff-coloured very fine sand ...	22	30
	5. Reddish-brown sand	5	35
	6. Buff sand, like No. 4, but not so clean	3	38
	7. Fine gravel and sand	½	38½
	8. Same as No. 4	9½	48
Contorted Drift.	9. Pale yellow loamy sand	3½	51½
	10. Dark reddish-brown loam, slightly mottled	9½	61
	11. Ditto, lighter colour	5½	66½
	12. Same as No. 10	5	71½
	13. Bluish, compact, hard, stiff, loamy clay (impervious)	3	74½
	14. Yellowish loam, with thin bands of ironstone	½	75
	15 & 16. Yellow loamy sand	5	80
Glacial Sand.	17. Dark grey, very compact sand ...	2½	82½
	18. Dark brownish, greyish sand ...	14	96½
Till.	19. Dark bluish-grey, stiff compact loamy clay, with small stones (impervious)	4	100½
Forest-bed.	20. Rounded grey flints, one to two inches in diameter	6	106½
Chillesford Clay. ?	21. Grey blowing sand	16	122½
	22. Light grey, stiff, compact marl (impervious)	½	123
Weybourn Crag.	23. Grey running sand, with fragments of shells	6½	129½
	24. Ditto, without shells	10½	140
	25. Bed of large flints	1	141
	26. Chalk.		

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From the sunk well Mr. J. C. Mellis obtained for me, in 1900, a large box of shelly sand, which yielded the following characteristic Weybourn Crag species. As to the wood, he writes: "I cannot vouch for the wood coming from the depth, though the men say it did." I notice, however, that the sand is full of fragments of wood, the clefts of which contain cemented shell-sand. I think, therefore, that we may accept the pine wood and the alder cone as truly belonging to the Weybourn Crag period.

Land and Freshwater Species.

Pinus (wood).
Alnus (axis of cone).
Helix hispida.
Pupa muscorum.
Limnæa truncatula.
,, palustris.
Planorbis spirorbis.
Planorbis albus.
,, corneus.
Lithoglyphus fuscus.
Valvata.
Corbicula fluminalis.
Pisidium amnicum.
Arvicola intermedius.

Marine Species.

Buccinum undatum.
Littorina littorea.
,, rudis.
Natica clausa.
,, Johnstoni.
Purpura lapillus.
Scalaria groenlandica.
Turritella terebra.
Trochus.
Astarte borealis.
,, compressa.
Cardium edule.
Corbula gibba.
Cyprina islandica.
Donax.
Leda oblongoides.
Mactra ovalis.
Mya arenaria.
Mytilus edulis.
Nucula cobboldiæ.
,, nucleus.
Pholas crispata.
Tellina balthica.
,, calcarea.
,, obliqua.
Balanus crenatus.
,, porcatus.
Platax woodwardi.
Raja.

The above lists show that at North Walsham, as at Cromer, we find a singular association of a sub-arctic marine fauna with a temperate or slightly southern freshwater fauna. The two are unmistakably contemporaneous, for the delicate freshwater shells

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are not things that could be washed from one stratum into another. It is interesting to observe among them the *Lithoglyphus*, a southern species so rare that the only other locality for it is the Weybourn Crag of East Runton. I have already suggested that the peculiar association of northern marine with southern land and freshwater animals is perfectly accounted for by the geographical conditions which held at the close of the Pliocene Period. The sea was only open to the north, the land was only connected with the south.* A noticeable point about this well is the abundance of the land and freshwater species in the Crag. When we travel from Runton south-eastward to North Walsham and Mundesley, we appear to be ascending the ancient estuary in which the Weybourn Crag and Chillesford Clay were deposited.

The third Well to which I desire to draw attention is a trial-boring at Metton, south-west of Cromer—a district in which nothing has been known as to the extent of the Crag or the depth to the Chalk. This also yields abundance of good water. I am indebted to Mr. J. C. Mellis for the samples on which the following short note is founded :—

METTON. Surface 118 feet above O.D.

		Thickness. feet.	Depth. feet.
	Soil	1	1
Glacial.	Gravel	5	6
	Boulder Clay	24	30
	Sand and boulder clay	20	50
Forest-bed.	Coarse-grained blowing sand, pebbles, green flints, and shells, *Cardium edule*, *Tellina balthica*	11	61
Weybourn Crag and Chillesford Clay.	Fine running sand and stones. *Littorina*, *Cardium edule*, *Corbula*, *Mytilus*, *Nucula Cobboldiæ*, *Pholas*, *Tellina balthica*	10	71
	Running sand with veins of fine micaceous clay and pebbles	34	105
	Shells and green-coated flints. *Cardium edule*, *Cyprina islandica*, *Leda*, *Mya*, *Nucula Cobboldiæ*, *Tellina balthica*, *T. obliqua*, *Littorina littorea* ...	1	106
	Chalk		

* See "Geology of Cromer" and "Pliocene Deposits of Britain." *Mem. Geol. Survey.*

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In this well also the Weybourn Crag rests immediately on the Chalk. The micaceous clay, which seems to represent the Chillesford Clay, here lies between two beds of shelly Crag. The upper one, however, may belong to the Forest-bed, which, west of Cromer, often shows marine intercalations. At present, we are unable to distinguish between the marine fauna of the Weybourn Crag and that of the Forest-bed; for the land and fresh-water species of the Weybourn Crag all (with the exception of *Lithoglyphus*) range upward into the Forest-bed, while the marine fossils of the Forest-bed (except some extremely rare mammals) are all found in the Weybourn Crag. Further knowledge may obliterate entirely the distinction between Crag and Forest-bed. A close study of the fauna does not support the view that the Forest-bed can be separated from the Crag and made into the base of a new division, to be classed as Pleistocene.

II.

MEMOIR OF ROBERT WIGHAM.

By W. H. Bidwell, *President.*

Read 29th October, 1901.

In the 'Transactions' of our Society there have been published from time to time memoirs of Norfolk Naturalists of bygone days; but up to the present there has not appeared any notice of Robert Wigham, who was an enthusiastic student of Natural Science, and whose work in the County as a field naturalist entitles him to such a record.

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Trans. Norf. & Norw. Nat. Soc. vol. vii. p. 298.

ROBERT WIGHAM.

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Robert Wigham was born on the 6th January, 1785, at Whitley Head, in the parish of Tanfield, in the county of Durham. As the adjoining parish is Wickham, it seems probable that his surname was of local origin, and was formerly spelled in that way. When quite a young man he removed to Norwich, where he was soon established in business as a tobacco manufacturer. Entomology was at first his favourite study; and his mother, who then resided in Newcastle, being in needy circumstances, he would often dispose of his good captures that he might contribute to her comfort; but he soon studied botany also, and furnished the list of plants and insects for 'Stacy's History of the County of Norfolk,' published in 1829. The editor of that work speaks of him as "an indefatigable, scientific, practical botanist and entomologist."

In 1831, and probably earlier, he was corresponding with Sir William Hooker; and Sir Joseph Hooker has kindly sent me copies of two letters which are in his possession. We may gather from these letters that he was assiduous and careful in collecting facts, and glad to communicate them to his correspondents.

NORWICH *15th Augst. 1831.*

DEAR SIR

I received your pamphlet for which I thank you and send you specimens of *H. sabaudum.* I yesterday spent the day at Seething with Mrs. Holt and found another habitat for the plant on the road near Framingham. I enclose a specimen and a few seeds of *Lathyrus aphaca.* The *Aspidium cristatum* I expect to be able to send you soon. I have been introduced to the Revd. Mr. Francis through whose interest I shall be able to procure it. I have not done much in botany this year as I am now in business for myself and have been moving my situation from St. Stephen's to the Old Haymarket No. 10, which has kept me very busy for some time. Please give my very best respects to your father, he will be very pleased to know I am doing very well in business having been now about a year engaged in it

Yours respectfully
R WIGHAM

I shall be glad to send you anything you want at any time and hope you will not hesitate to name your desiderata.

The next letter is of much later date, and is concerned chiefly with *Phallus iosmos*, a fungus which Curtis had mentioned in 'British Entomology' as growing in abundance on the sand-hills near Lowestoft, in the middle of October, and which he found to

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have a scent something like Violets at a distance, but very offensive when the plant was dried. This statement does not agree with Wigham's observations.

NORWICH *Nov. 29th 1853*

DEAR SIR

I was very much gratified on receiving your kind letter of the 19th inst with the notices of your museum and for which I sincerely thank you. I am glad that you found the information concerning the rushes so interesting, and will be exceedingly proud if I can at any time be of service to you either in regard to information or by sending you any specimens of our Norfolk plants you may like to have. About seven or eight years ago Mr. George Sothern and I met with the *Phallus iosmos* on the dunes near Caister, plentiful in September. I have seen it there since, and also as far north as Hemsby and I make no doubt it will be found also near Winterton, & dried a few specimens at the time and meant to have sent you some and I observe you notice in your English Flora a want of information respecting it, the specimens I dried I did not think good enough to send I therefore determined to send you fresh specimens and went there again in September But I was too late the plants were all in the last stage, and from business requirements and indifferent health, I have not been able to find an opportunity since. We found there also at the same time *Spharia punctata* not on horse dung but invariably on dung of the ass. I did not observe that the *Phallus iosmos* had a smell like violets when growing and that it was offensive when dried It has a smell much like boiled starch when recent and has not the least of an offensive smell when dried, as you will perceive by the specimens sent; I think there must be some mistake about violet scented, which I apprehend ought to be *violet rooted* as the uterus which is about the size of a bantams egg is beautifully and deeply tinged on the *underside* with a violet colour, and the roots which consist generally of one about an inch long and sometimes one or two small ones all beautifully tinged with the same colour. The plant altogether is much smaller than the *impudicus*, of a darkish brown colour and generally about four inches high, the tallest never exceeding five inches as far as I have observed. I have frequently heard of your museum and should very much like to see it, but I very seldom remain all night in London, I am up by rail in the morning and home again at night and before we had the rail I was up by the coach and home the next night, however when the fine weather comes I will endeavour if all is well to see it. I have been very much gratified lately by a correspondence with Professor Walker Arnott. I met him last year at Belfast and this year at Hull at the meeting of the British Association. He is very busy with the diatomaceæ at present, and I volunteered to send him a few specimens and I sent him a few from Mr. Brightwell and also a few from a very clever friend of mine here Mr. Bridgman. I had a long letter yesterday from Professor Arnott with a few slides as samples of his way of mounting them, they are very neat

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indeed and I mean to adopt his method when I begin to collect again, for I have not done much amongst them for these last two years having had but indifferent health for that time, but I was at the Hydropathic establishment at Umberstrode near Birmingham last winter and was a great deal better by the process and now I am better than I have been for several years. I am about getting a good new microscope with Ross's glasses and mean to have a fresh start; I was very much pleased a few years ago by meeting with *Diatoma striatulum* at Cromer on *Cladophera latevirens* plentiful in May and where you had first found it many years ago. I found it on several of the *Polysiphonias* also, particularly the nigrescens and elongata. I had the pleasure of seeing your son at the Ipswich meeting please give my best respects to him. With best respects to yourself and family and sincere wishes for your welfare.

I remain yours very respectfully

ROBERT WIGHAM

It will be seen from the conclusion of this letter that in later life Robert Wigham had been at work at the Diatomaceæ, and he worked with his microscope with the same enthusiasm that he had shown in all his natural history studies. In his letters Professor Walker Arnott thanks him for sending gatherings from places in Norfolk and Suffolk, which he had found to contain some truly good things; among these was a Chætoceros, which was afterwards named 'Wighamii,' and which is referred to by Mr. Thomas Brightwell in his paper on Chætoceros in the 'Journal of Microscopical Science' for 1856, where he says:

"We have named this species after the discoverer, Mr. Wigham, an excellent, practical botanist, indefatigable in the pursuit of his favourite study, and most liberal in his communications to his friends."

Robert Wigham for many years attended regularly the meetings of the British Association; and in an interesting letter to his friend Mr. Henry Bidwell of Ipswich, he describes that held in Belfast in 1852. After giving an account of his journey, and his stay at Dublin on the way, he writes:

"I reached Belfast about half-past three, got my ticket at the reception room, which is in the railway station, and got very comfortable quarters at the Plow Hotel in the corn market. The sections hold their meetings in the Queen's College, a most superb place. I met Professor Allman on Thursday morning, who immediately put my name on the committee, and introduced me to

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Professor Dickie, Professor of Botany Queen's College, a very clever man and an excellent Botanist. He and I are already fast friends. I have also exchanged cards with Professor Thompson of King's College, Aberdeen, and the Rev. — Hincks of Sheffield, a very clever young man both as a botanist and zoologist. I am much disappointed at Mr. Peach not being present, the cause of which I cannot learn, and the Rev. D. Landsborough is at Gibraltar; but I accidentally met his son-in-law, Mr. Stark, at my Hotel. He is a nurseryman in Edinburgh, and was over on business. The Prince of Canino is here, we went from London in the same train. There was also Mr. Lovell Reeve and Dr. Lankester, but above all the people in the world who do you think was there but old Dr. Fowler, with his old story which he had before told at Ipswich. Professor Airey was not, or rather is not, present from some domestic cause, and Sir Roderic Murchison acted in his stead. Professors Owen and Forbes are here, also Sir David Brewster . . . . We had the Lord Lieutenant at the sections on Thursday; he is a fine looking man, but *that is all*, but he appears to be pretty well received here by all classes. To-day I have been out about three or four miles in the country to see what they call the Giant's Ring. It looks like an intrenched camp of a circular form, with a cromlech in the middle, and covers about four acres. I saw a good deal of *Butomus umbellatus* in the river Laggan, which runs down into Belfast Lough, and also a good deal of the *Villarsia nymphoides* and gathered *Chlora perfoliata* on Bray Head on Tuesday. Professor Allman tells me it is not uncommon in Ireland. The excursions will be on the 9th, and I mean to go to the Giant's Causeway. Two steamers are engaged to carry the members. After all is over I mean to spend a day in the Isle of Arran, and return by Glasgow and Edinburgh."

Robert Wigham was throughout his life the valued correspondent of many scientific men, but he published scarcely anything besides the Norfolk lists already mentioned. He was a man of great kindness of heart, especially to the young, whom he always endeavoured to interest in those pursuits from which he himself derived so much enjoyment. He had but one son, James Bagnett Wigham, who died in 1851. He was the author of a paper entitled "Additional facts respecting the origin of the Sandpipes

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in chalk near Norwich," published in 'British Association Report,' 1839.

Robert Wigham died on 15th February, 1855, and the editor of a Norwich paper, in an obituary notice, paid the following tribute to his character: "Indefatigable and enthusiastic in his favourite study of the Natural Sciences, his untiring zeal and extraordinary vigour of intellect, together with an unassuming mien and most generous disposition, endeared him to a large and extensive circle of labourers in the same field, by whom his loss will be deeply regretted. Self-educated and raised to comparative affluence by his own laborious industry, his bounty has been on many occasions freely extended to the needy. Esteemed and beloved by all who have shared in his friendship, his death will be long felt and deplored by those with whom he was most intimately associated."

III.

ANCIENT RECORDS OF THE OCCURRENCE OF CERTAIN CETACEANS ON THE NORFOLK COAST.

By Thomas Southwell, F.Z.S., V.-P.

Read 29th October, 1901.

Mr. le Strange has been good enough to send me the following extracts relating to the stranding of Cetaceans on the shore of his manor of Holme-next-the-Sea, the first of which has in part been published by Blomfield, in the 'History of Norfolk' (1808), vol. x. p. 334, and thence copied into subsequent works of a like nature, but has never, I believe, appeared in its entirety, whereas the latter has not previously been made known. Both accounts are exceedingly interesting, and with Mr. le Strange's permission I have much pleasure in bringing them under the notice of our Society.

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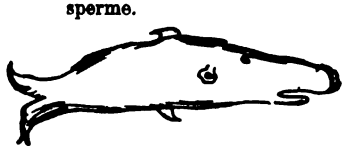
The extracts were made from a MS. volume of "Notes by Sir Hamon (1583—1654) and Sir Nicholas le Strange, relating to their estates," extending from the year 1612 to 1723; the first of which, as follows, occurs on p. 101, and is in the hand-writing of Sir Hamon:—

YE WHALE. Dec: 6. 1626. A whale of the kinde called Jobertus was cast upon Holme Shoare, the wind blowing stronge from Northwest, the length of it was 57 feete. the bredth of the nose ende 8 feete, from the nose ende to the eyes 15ft½, the eyes about the bigness of an oxe eye. The netherchapp did close and shutt about 4 feete short of the length of the uppr chappe. The netherchapp narrowe towards the ende and therein 46 teeth like the short tusks of an elephant, the upperchapp had no teeth but sockets of bone for to receive the teeth that fell thereinto, the netherchapp about . . feete bigge, betwixt the eyes about . . feete broade; It had only two small finnes, on ech syde one. It was a male whale, and had a pisle about 6 feete longe, & about a foote in diam̃ att the body, & from thence conically taperinge. the belly of the fish was a little whitish, upon the backe itt had a very short & small finne; the bredth of the tayle from one outward tipp to another was 13½.

The Manner of the takeing the sperme & oyle was this & first of the sperme.



the fish being like a woollpacke wth a greate head hath many and diverse cells (lyeing crosse the head) wherein the sperme lyeth. then the cutter toke a great knife of iron fastned to the end of a pole or staffe wth a socket to putt the staffe fast like a cow rake or such like, & cutteth lengthwayes in the head a greate hole or cant towards the nose and but short thereof a foote or two, then doth he take a dish or cupp of wood & wth the same taketh out the sperme wch when it is hott runneth out of the fish like liquid cristall haveing a more glassye & shininge coulour & brightnesse than any water that wch runneth purest is putt into wooden vessells by it selfe, that wch congeales by it selfe, and the foule or durty sperme wch is scraped up from the sand or other foule place by it selfe. the Cutter works from the nose ende upward toward the fish & cutting the bagge or cell on the upward part forceth the cell wth his knee (he standing in the hole he cutts out) as one setteth his knee to a beare vessell & draweth out the sperme as beare or water out of a vessell, & slitts the skinn & thicke filme of the cell next unto him lower and lower untill he come to the bottome, and then cuttinge away the unprofitable spongy cells wch are drawne out, he cutteth & broacheth another cell, and so poeeds until he have wrought out all.

The Oyle is thus made.

The fleshy part wch is fattest ever on the backe & the best is cutt wth a greate knife into peeces as bigge as a man can well carrye upon an hand

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hooke (whereof Sundry are made on purpose) all these peeces are layd by upon the sands, and after a copper or two sett up, and scotch Coale or sea Cole pũyded, & the great peeces are shredd into small peeces about ¼ or ½ inch thicke & an inche or 2 broade, & these gobbets are taken out & flunge away, & more putt in, & So pceeded wth until all be boyled, pũided there be also Caske or coppers ready to putt up the oyle.

Charge of ye whale in Cuttinge up watching & gratuityes.

	li	s	d
To Goodwin 5li for cutting up the body & 5d a day to a butcher for taking out the sperme ...	43	18	10
Knives & other necessaryes	2	14	6
house to boyle in of deales. wth the deales ...	11	12	6
coppers & boylinge	11	10	8
caske & hoopinge	19	17	4
ffraught & cariage of oyle & sperme	7	4	8
making & Kenchers charges Ridinge up & downe	5	9	4
	* 101	17	5

I sold the whale for 25li & reserued ¼ for my selfe of aduenture.

Sperme sold to Mr Jo: Hayes of London Febr: 6. 1626.

	li	s	d
45 cwt weight att 48s ℔ cwt	108	0	0
to Mr Tho: March of Linn 38 cwt att 18s ℔ cwt	34	0	0
to Mr Hayes 4 Tunne & 3 hogsheads of oyle att 13li 6s 8d ℔ tunne	63	0	0
Summ 205li 0 „ 0.			
li s d cost 7 „ 17 „ 4 { Sold to Mr. March 1 copper ...	2	3	0
{ Sold by Mr. Partridge 1 copper ...	4	14	0
Sold to Silv: Byles the boyling house	5	0	0
Sold by Mr Partridge other trifles		9	7
Summe total	217	6	7
The charges	101	17	5
the purchase	25	0	0
Summe	126	17	5
wch deducted resteth to be divided	90	11	2
¼ thereof	22	12	9 ob.
to wch add 25li & my p is	47	12	9 ob.
I bestowed upon Gode P.	2	0	0
I payd for the use of the Cable	0	10	0

* The items here given are correct so far as they go but they are not complete; several blank spaces are left which, like some of the measurements were evidently intended to be filled in later.

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On reading this accurate description of the animal and the circumstantial account of its cutting up and disposal, one cannot help being struck with excellence of the one, differing as it does diametrically from the vague and worthless descriptions of stranded Cetaceans we are accustomed to read in the present day, which appear carefully to pass over every feature helpful for their identification—whilst the methodical way in which the "making off" was proceeded with was worthy of an experienced whaler, not to mention the business-like profit and loss account, all of which tend to emphasize what we know to have been the case, that Sir Hamon was no ordinary man but, in addition to his thoroughly practical business habits, an accurate observer, gifted with the power of recording what he saw, as witness his remarkable account of the Dodo, which he saw exhibited in London about the year 1638.

In the postscript of a letter to le Strange dated 11th June, 1653, Sir Thomas Browne asks for further information with regard to this whale; this was embodied in a long and learned critique, on the *Pseudodoxia*, filling 85 pp., which Sir Hamon sent him (Sloane MSS., in the Brit. Mus. No. 1839), on the 27th page of which the writer states that the Whale "was of ye kind called a Jobertus, or Woolpack, a male 57 feet long, and of a very great girth of body, 46 teeth." It is in this lengthy critique that the account of his visit to the Dodo, before referred to, is contained.

With regard to the name applied to this specimen, Mr. le Strange tells me that in the manuscript a blank space was left for its insertion, as was also done for certain measurements, which were never filled up, and that the name does not completely fill the space. It was probably called a Woolpack Whale, from its apparently ungainly proportions, especially when lying on the shore distended with gas, but the name, "Jobertus," is most likely a varient of "Gubartes," "Gibbartas," or "Jupiter fish," which Anderson subsequently, in his 'History of Iceland and Greenland' (1747, p. 220), applied to one of the Fin-whales, probably *Balænoptera rostrata*, judging from his description, especially that of its baleen which he says is short, white, and brittle. It would be interesting to discover le Strange's authority, for the name which he evidently misapplies, but unless it were inserted in the blank space left for it long after the MS. was written its application would be earlier than Anderson's time, which was 120 years later.

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This specimen, although the first instance of the stranding of the Sperm Whale on the Norfolk coast of which we have a complete account, is by no means the first which had occurred, in fact, from the middle of the sixteenth to the middle of the eighteenth century, many such events in European waters are to be found recorded; and an early example must have been the Cachalot, of which the base of the skull, used as a chair, is preserved in St. Nicholas's Church, Great Yarmouth, and for the painting of which a charge of five shillings is made in the Churchwardens' accounts in the year 1606. Restricting ourselves to our own county we find some twenty years later than the Holme Whale, Sir Thomas Browne mentions that a larger individual of the same species was stranded near Wells, and it is probable this latter individual led to the chapter in the *Pseudodoxia Epidemica*, devoted to the Spermaceti Whale; the date of the occurrence of this latter example, of which I can find no further particulars, would probably be about the year 1646. Another Sperm Whale seems to have occurred at Yarmouth, about the year 1652, for there is a letter from Sir Thomas Browne (Sloane, MSS. 1847, fol. 56), evidently (from the date of the reply) written in that year; asking a correspondent to obtain from Mr. Arthur Bacon of that town, the particulars with regard to the [Sperm] Whale whereof he had the cutting up and disposal.

The statement by Sir Thomas Browne when writing of the Sperm Whale (Sloane, MSS. 1830, fol. 23), that eight or nine of these animals came ashore on one occasion on the Norfolk coast, and that two of them "had young ones after they were forsaken by the water," has always appeared very doubtful, as it would indicate that a "school" of adult females had wandered out of their proper latitude, whereas I believe the stragglers which have been met with in our waters have been, almost invariably, solitary males or herds of young males; a letter from Browne to Sir William Dugdale (*vide* Notes on the Nat. Hist. of Norf., p. 92) however throws a fresh light on the subject, for he there states that these were "a kind of small Whale . . . which seamen call a Grampus," the name applied by le Strange to the Beaked Whale (*Hyperoodon*), the subject of the next extract from the manuscript, and much more likely animals to perform such a feat. The only instance of the occurrence of females, or a mixture of sexes in the same "school" known to me is mentioned by Anderson (*l.c.* p. 248),

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who says that on the 2nd of December in the year 1723, a school of seventeen Sperm Whales came ashore at the mouth of the Elbe, half of which were males and half females; these were probably immature, for Beale the great authority on the life-history of this species expressly says that the schools consist first of females accompanied by their young, and secondly of the young and half-grown males; but that the large and full-grown males always go singly in search of food.

A very remarkable incursion of a herd of Sperm Whales on the East and South Coast of England is referred to by Dr. J. E. Gray, in the B. M. Cat., Seals and Whales (Edit. 2, p. 203), he does not give the full particulars, and is misleading as to date, but states the source of his information to be a letter from Walberswick, on the Coast of Suffolk, dated 7th March, 1788, in the form of a newspaper cutting, inserted in Sir Joseph Banks' copy of the Phil. Trans. (vol. lxxvii, pt. 2, p. 450), in the B. M. Library.

Through the kindness of Dr. Laver of Colchester, I have seen a transcript of this cutting, and as our own county participated in the visitation I give the paragraph in full. After stating that a Whale, species unrecorded, had for a week past frequented the bay off Walberswick, the writer goes on to say, "The most extraordinary instance of that sort was in February, 1763, after a hard gale of wind, northerly; when no less than twelve Whales which undoubtedly came out of the northern ocean, were towed or driven on shore at the following places; all of them dead, and in a high state of putrefaction excepting one.

2 near Lynn in Norfolk.
2 on the coast of Essex.
2 at Birchington in the Isle of Thanet. The skeleton of one of these, about 58 feet long, a very great curiosity, has been many years exhibited at Rockstrow's Museum, Fleet Street, Strand.
2 at Broadstairs near the North Foreland.
1 at Hope Point in the river Thames. This was the only one that was seen alive. He ran aground and smothered himself in the mud, and was afterwards made a show of in the Greenland Dock.
1 at Deal.
2 on the coast of Holland.

"These were all of the spermaceti kind, and of the male gender.

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The writer of this paragraph cut up two of the Whales. The dimensions of the largest Whale was as follows: length 62 —, depth or diameter from back to belly 18 —, breadth of the tail from fork to fork 15 —, length of the under jaw 14 —, which contained 43 teeth. The bone to which the tail was annexed, measured three feet in circumference, and was cut through with a saw. The cavity of the head bone was capacious enough for three or four men to sit in. The eyes were not much larger than those of an ox, and were placed about 12 feet from the nose. The blubber and the spermaceti and oil that was produced from the body of this and another Whale 54 feet long, filled 26 beer butts, and about 20 Iceland barrels. The great fish was in such a state of fermentation and putrefaction that the oil ran out at many ruptured parts of his body quite clear and warm as milk from the cow." It will be observed that all the individuals of this "school" were males.

As a corollary to the above I may quote the following which appeared in the 'Zoologist' for 1883, p. 131. "An old newspaper of May 17th, 1762 [1763 ?] states that the 'spermaceti and blubber of the four Whales which were ashore at Birchington and Broadstairs were sold last Wednesday for £374 18s., and that at Deal for £149, which was much more than was expected.'" There is a disparity in the dates, but it is evident that the Whales referred to were identical with those mentioned above. I know nothing of any subsequent occurrence of this species on the Norfolk coast.

The second entry occurs later on in the same volume, and is in the writing of Sir Nicholas le Strange, son of the above, it is as follows:—

Iuly 1700

WHALE OR GRAMPUS. On the 21st day the wind being westerly came up on Holm Shore over agt Holm Bridg or little more East a GRAMPUS so calld. The length of this fish from nose end to Tayle abt 25 ft. and abt 16 ft. circumference at ye biggest part of The Body as near as wee could judg it. It was bruis'd & the Body broken & putrifyed when it came up so not knowing where to dispose of it presently I sent down a cart wth empty Tubbs and as soon as the Tide fell from it wch was abt 10 at night I sett 5 men to worke took off all the Fatt Skinn from that side wch lay upwards by 4 next morning Then turn'd it over by ye help of Ropes & horses, & in the next Tide took off the Fatt from ye other side. The manner of cutting up was thus

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CUTTING UP. The fatt skinn being very like fatt Bacon in some places 2 or 3 and in some near 5 in thick, the workmen wth sharp knives outt a long peice out, & so continued the cours still keeping the Inner prt of the outt deepest, to receiv the oyle wch one man still wth a small ladle took out, & put into a Tubb by it self, this being calld *Trayne Oyle* and reckned the best.

TRYEING YE OYL. The manner of Boyleing or Tryeing. I sent 2 large kettles to ye Cinder hous in Balland wch sett upon Brandlis or Trevetts in the chimney kept 5 men cutting on wooden Trayes & bolls into small peices near an inch thick putt these into ye kettles wch one man tended and as the oyle boyl'd up, straind thro' a seive into a Tubb, & thence putt into ye casks.

PRODUCE. The *Produce* of the Fish was abt 3 Hogsheads of Oyle { 1 of Train / 2 of Tryed } Upon Enquiry I found that there is but 30 gallons alloud to a Barrell of Oyle, so 3 Hogshds is 6 Barrells & better.

CHARGES. The Charge of Cutting & Tryeing it up &c was	ti	s	d
5 men 2 tides cutting it up at 2s ꝑ man 5 men 2 men tryeing	0	10	00
Besides Casks & Tooles & Firing & some diett & Drink I allowd the men to make amends for ill savour of theyr Worke	0	10	00
	1	00	00

I do not think this fish of the same Whale sort mencon'd by Sr Hamon page ye 101st at ye other end of this Book tho' this was a male ffish and had a pizzle in ye place describ'd, and had a hole of abt 4 in. broad at ye joyneing on of ye head to the back wch wee trac'd down to the Palate of ye mouth & by wch I suppose it spouted water.

The shape of ye Fish I have Describ'd on ye margin and after haveing taken off ye Fatt, I caus'd the workmen to open the Body where wee found very little quantity of Gutts not more yn would fill a Bushell. The Pouch or Stomach empty, except abt 2 qrts of sharp clawes undigested. the liver fleshy & worth nothing, for upon boyleing it yeilded nothing but a thick bloody matter. It had a great Roll of dark spongy flesh the whole length of the backbone wch toke more room than all the rest of the Intrayles. It had no teeth in either Jaw, neither had the lower Chap any sockett at ye closeing to ye upper, but ended like a Pike's. The great Bunny or swelling out on ye head yeilded very little fatt, & upon opening found no skull or Braines but 2 large sponge bones standing up answering the lower Jaws, & the whole space fill'd wth a very tough pale fleshy substance much resembling (in ye cutting at least) the par wax of a bullock, & held so throughout to ye palate or roof of the mouth.

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Although called a Grampus, Sir Nicholas's excellent description of the animal at once indicates that it was a male example of *Hyperoodon rostratus*, which came ashore at Holme, this is confirmed by the accurate outline in the margin of the MS. (here reproduced) which Mr. le Strange has been good enough to have photographed,* and moreover from the conformation of the head, the great "bunny" or swelling particularly mentioned, it was evidently a nearly adult male, a condition in which it is of rare occurrence in our waters, adult females often accompanied by their young being of most frequent occurrence. Of course, at the time of this writing, the Hyperoodon was not distinguished as a species, and the word "Grampus" had a wide application; but Sir Nicholas at once discerned that the species was different from that which came under the notice of his father, and was described earlier in the same volume. After the account of the cutting up and trying out of the oil, by which it appears that he obtained 180 gallons of oil at a cost of £1, including "some diett and drink allowed the men to make amends for ill savour of their work," he proceeds to give a very intelligent account of the anatomical peculiarities, which in spite of the "ill savour" he did not fail to observe; thus, he traced the breathing apparatus from the "blow-hole" to the palate, and he may readily be excused for arriving at the conclusion that the passage was for the ejection of water instead of air, for it was not till long after that the full significance of the mode of respiration of the Cetaceans was understood. The two quarts of "sharp clawes" found in the stomach were the beaks of Cuttle-fish, which are now known to form the food of these animals; and the great roll of "dark spongy flesh, the whole length of the back-bone" consisted of the lungs with their great plexus of blood-vessels; the apparent absence of functional teeth in either jaw which formed such a contrast to the well-furnished mandible of the "Woolpack" Whale did not escape his notice, nor of course the

* The figure is perhaps rather too robust but on the whole fairly accurate, and it will be observed that there is no medial notch in the tail, the absence of which is a feature in this species. The first recorded example was, I believe, a young female stranded at Maldon, in Essex, on 23rd September, 1717, which is figured (but less accurately) and described by Samuel Dale, in his 'History and Antiquities of Harwich' (1730, p. 411, Tab. xiv.): this earlier sketch of Sir Nicholas le Strange's is therefore very interesting.

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great "bunny" (a good old Norfolk word) on the forehead, which is so remarkable a feature in this species. But although he failed to locate the position of the animal's brains, and was even deceived as to the formation of the skull, he penetrated through and remarked upon the fibrous mass, like the "pax-wax" of a bullock, which filled the space between the enormous maxillary crests and extended to the palate; but he does not seem to have discovered that the anterior cavity in this swelling contains a considerable quantity of very pure oil, almost equal to spermaceti. I think it must be admitted that the two accounts penned two hundred and more years ago by these remarkable men evince an amount of intelligent observation and research which it would be difficult to find equalled even in the present day in simple country gentlemen, and we have reason to be proud of these fathers of Norfolk Natural Science.

IV.

THE BIRD'S WING, AND THE PROBLEM OF DIASTATAXY.

By W. P. Pycraft, A.L.S., F.Z.S., &c.

Read 26th November, 1901.

Of the many ornithological problems awaiting solution, perhaps the most puzzling, and the most fascinating, is that which deals with the mysterious absence of a quill feather from between the fifth pair of secondary wing-coverts. Consequently, I have made this subject what I may call the climax of the present paper. Perchance some members of the Society may have heard little or nothing hitherto of this remarkable fact, and may now, after the perusal of these pages, be induced to join in the endeavours which are being made to clear up the mystery.

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The Bird's wing is in itself an exceedingly interesting organ, viewed from an evolutionary point of view; and I have, therefore, commenced this paper with a brief summary of its salient features, designed to stimulate an interest in the subject, as well as to help those not already familiar therewith. An appreciation of the general morphology of the wing is certainly necessary to those who intend entering the lists of the great puzzle competition: What is diastataxy?

A glance at the skeleton of the wing of an adult of any of our common birds will be sufficient to convince the trained observer that it is a highly specialized structure, built up by a process of slow transformation from some originally ambulatorial fore-limb.

His ground for such a conclusion will be the fact that the carpus, or wrist, contains but two free elements, whilst the metacarpal bones and phalanges have obviously undergone great changes and modifications, thus rendering the limb, as a whole, an unique

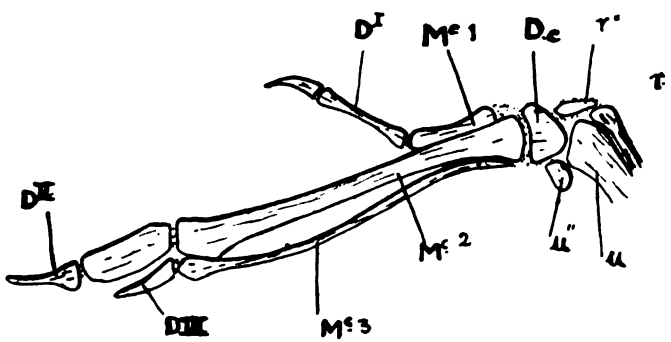

Fig. 1.

Fig. 1. The manus or hand of a young Rhea, showing the separate elements of the wrist joint, and the distinctness of the bones of the hand. r and u represent the portions of the radius and ulna, the bones of the fore-arm. r' and u'' the carpal or wrist bones of the proximal or inner row, known as the radiale and ulnare. D.c is the mass of fused wrist bones described in the text. Originally there were three separate elements—one for each metacarpal bone. The three now fuse together to form what is known as the distal—or meta—carpal mass. Ultimately this mass fuses with the metacarpal bones, and undergoes slight changes of form so that all trace of the distinctness which obtains in the nestling is lost. Compare this figure with the skeleton (Fig. 3) on page 317, representing an adult wing of a Hawk.

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structure. He will assume for this limb a primitive pentadactyle form with numerous separate carpal bones; this primitive five-fingered or pentadactyle form being the common type to which every fore- and hind-limb, above that of the fishes, can be reduced. By way of testing such a conclusion, the carpus, or wrist, and hand of the nestling bird will be first examined. Such an examination will show, as will be seen in Fig. 1, that the metacarpals, only imperfectly distinguishable in the adult, are now seen distinctly as three separate elements (Mc 1, 2, 3), whilst in addition to the two free carpals of the adult (r′ u″) he will find a third distinct semi-lunar mass capping the bones of the metacarpals (D.c) and representing, therefore, a some-time separate row of distinct carpal bones. This region of the wing, at this stage, it is significant to note, *exactly* corresponds with the permanent condition of the same region in the ancient *Archæopteryx*. Turning now to the embryo, if he be fortunate, he will find, in addition to the two proximal carpals of the adult,—the radiale and the ulnare—a third element, the intermedium; whilst the fused distal mass of the nestling will now be seen to consist of several distinct elements. Furthermore, traces will be found of at least one of the postulated primitive five digits in addition to the three which permanently remain.

Remembering that all the modifications which this limb has undergone have been to further the ends of flight, he will turn next to such other cases as may be found in which this limb has become transformed for similar ends. The Bat and the extinct Pterodactyle will be found the only vertebrate parallels, and it is with these that the wing of the bird will now be compared.

A comparison of the wings of these three forms would at once reveal a very striking difference between the bird's wing and that of the Bat and the extinct flying Lizard. In the two latter (Fig. 2, A, B,) we should find that the wing was formed by a sheet of membrane, extending from the body outwards to the tip of the fore-limb, and supported by one or more digits; whilst, in the bird, the membrane is more or less completely replaced by a system of separate, elongated, overlapping blades, differing in nowise, save in size, from the general and remarkable body-clothing which we know as feathers. These overlapping blades we know as the remiges or quill feathers.

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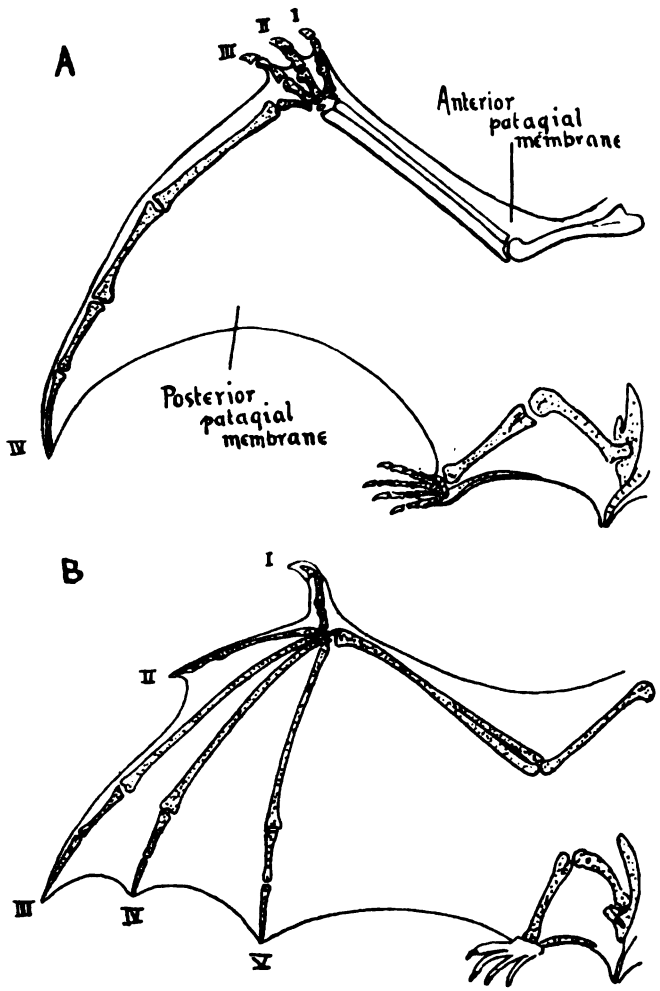

Fig. 2.

A. Outline figure of the wing of the extinct flying Lizard, the Pterodactyle, formed by a thin membrane stretched between an enormously elongated digit and the body.

B. Outline figure of the wing of a Bat, formed by a thin membrane similar to the above, but supported by several digits like the ribs of an umbrella. Note that the hind-limb in both these instances is engaged in the extension of this membrane.

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In the skeleton of these wings we should find more differences. Thus, in the Bat (Fig. 2, B), all five digits are represented. The pollex, or thumb (D), is often long and armed with a large claw. The remaining digits are of great length and slenderness, and so arranged that they support this membrane much as the ribs of an umbrella support the covering.

In the Pterodactyle (Fig. 2, A) four or five digits are recognizable; but of these, only the last, or little finger, takes part in supporting the wing-membrane, and on this account it is prodigiously developed. The remaining fingers are small and weak, and would probably have disappeared in course of time had not the species itself become extinct.

In the bird (Fig. 3), as we have just pointed out, only three digits remain, and these represent the thumb, and first and second fingers. This wing is seen in its most primitive form in Archæopteryx, the extinct bird of the Solenhofen Slates of Bavaria. In the manus of this bird, although no more than three fingers are present, the wing is yet more primitive in type in that each digit bears a large, ungual phalanx, which supported, during life, a still larger sheath constituting the claw. Only in the young Ostrich among living birds has a claw been found on the third digit. That of the first and second is often present, and even large, *e.g.*,—the South American Opisthocomus, or Hoatzin.

The metacarpal bones of the Bat and the Pterodactyle are free. In the bird the three metacarpals are fused together: the first is very small, the second and third subequal. The fingers are peculiar in that the first, or thumb, is short; the second, or index, is relatively long, whilst the third is again short (Fig. 3 and Fig. 1). The number of phalanges in each digit varies. Thus the thumb may have one or two phalanges, the second finger three, and third two. In Archæopteryx the third digit had four phalanges. As will be seen in Fig. 3, the hand and fore-arm, when extended, form a long, bony rod, which serves for the support of the bases of the quill-feathers. These, as we have already seen, almost entirely take the place of the anterior and posterior patagial membranes of the Bat and Pterodactyle.

As we have already pointed out, the difference between the

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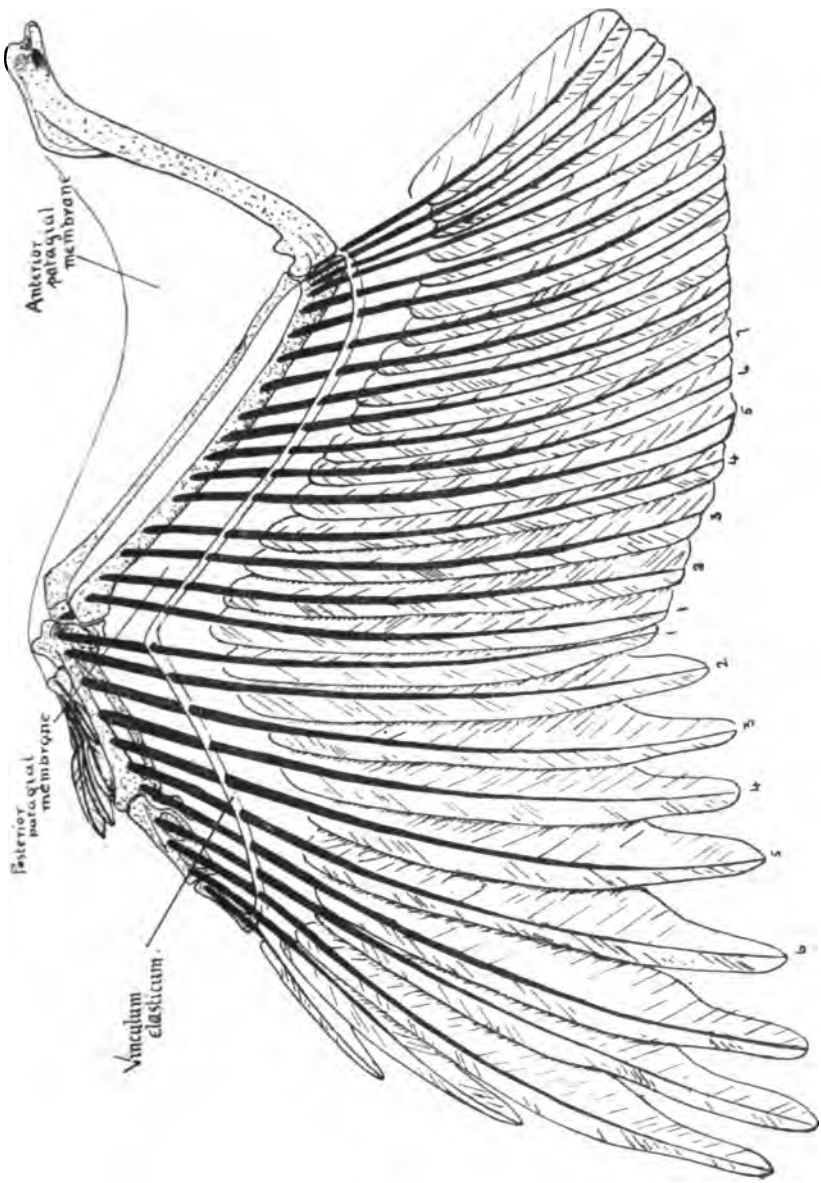

Fig. 3.

Fig. 3. Outline figure of the wing of a bird, formed by numerous distinct, overlapping, ribbon-shaped structures of a horny texture taking the place of the membranes seen in Figs. 2, A, B.

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wings of the Bat and the Pterodactyle on the one hand, and the bird on the other, lies in the fact that in the two former it is formed by a sheet of membrane; whilst in the latter (Fig. 3) the membrane is almost entirely replaced by isolated, overlapping, ribbon-shaped plates of complex structure, known as the quill feathers or remiges. The wing membranes of the former *are*, however, represented in the bird, as will be seen by a reference to Fig. 3. It has been suggested, and the suggestion is by no means improbable, that these were once of much greater extent, and served the purposes of flight. Both the upper and under surfaces of these membranes, it is supposed, were scale-covered, and, it is further suggested, that the scales, by a gradual increase in size, have given rise eventually, by slow transformation, to feathers. The gradual development of these, from the primitive, original scales, was followed by an equally gradual degeneration in the size of the primitive wing membrane,—the membrane diminishing as the developing feathers became more efficient—till the form and proportions of the existing wing have been reached.

This brings us to the second part of our theme—the arrangement of the wing-feathers of living birds.

This subject has received much attention, several memoirs having been devoted thereto.

Any one who will open out the wing of a freshly-killed bird, and examine it closely, will notice that the feathers thereof overlap one another after the fashion of tiles upon a roof, or, a still better comparison, of scales upon a fish or reptile. A comparison of several wings of different species of birds would furthermore show that, though all agree in the method of the overlap of the remiges and the row of coverts immediately above them, yet very distinct differences in this overlap obtained in certain of the rows beyond these. Thus, for instance, in the wing of the Little Stint, Fig. 4, the overlap of the remiges, the row of coverts resting upon them, and numerous rows of small feathers lying along the anterior border of the wing is distal. That is to say, the free edge of the vane of the feather is turned away from the body, or towards the tip of the wing: whilst in the intermediate rows the overlap is proximal, the free edge of the feather being turned towards the

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body, or away from the tip of the wing. For convenience sake, the wing feathers are divided into (A) remiges or quills, and (B) tectrices or coverts.

The remiges are the large feathers seated along the hinder border of the wing, which sustain the flight. They constitute two series, (A) the primaries or metacarpo-digitals, from their position on the hand; and (B), the cubitals or secondaries, which rest, by their bases, upon the fore-arm.

The coverts are distinguished as the major, median, minor, and marginal coverts. They clothe both the upper and under surface of the wing in all except the flightless Struthious birds, in which the under surface of the wing is bare. For the moment, however, we will confine our remarks to the dorsal aspect of the wing. Of the major and median coverts there is never more than a single row. The number of rows of minor coverts varies from one to five or six. The number of marginal coverts is also variable.

In some birds all the coverts of the upper wing surface have a distal overlap. In the majority of cases, however, the minor coverts have either a proximal overlap throughout, or the inner feathers have a distal and the outer a proximal overlap.

The figure illustrating this part of our subject will show at a glance the different forms of overlap, and will also point out how important a bearing it has on questions of systematic zoology, and for such artists and draughtsmen who esteem accuracy worth attaining.

It will be impossible, in studying the overlap of the wing feathers, to escape noticing the fact that in a very large number of wings there are indications of disturbance having taken place in certain of the rows near the carpus or wrist; the major, median, and minor coverts being all more or less markedly involved. The disturbance in question most generally takes the form of a break in the continuity of the rows, suggesting, as Mr. Goodchild has aptly described it, a process of "faulting." Thus, the first four major and median coverts appear to be markedly longer than the remainder of the series to which they belong; above the lengthened median coverts there appears to be, what has been called a supplementary or intercalary row, and beyond this all is normal (Fig. 4 A).

If we now endeavour to solve this mystery, and begin by raising

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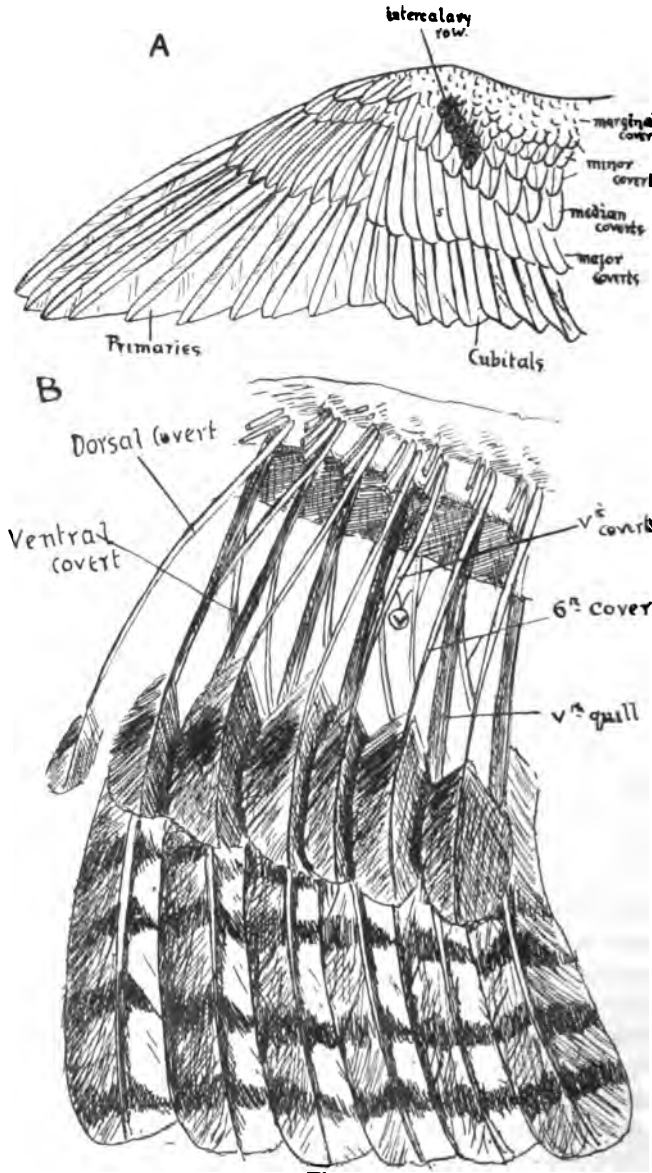

Fig. 4.

A. Upper surface of the wing of a Little Stint (*Tringa minuta*), to show (*a*) the difference between the "distal" and proximal overlap (the former is shown by the major, and the latter by median coverts), and (*b*) the faulting which result in the formation of the "intercalary row."

B. Upper surface of a portion of the wing of an Owl, to show the diastataxic condition of the wing—the absence of a quill between the fifth pair of major coverts.

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the major coverts, we shall notice that they are closely bound to the remiges; a pair to every remex—the dorsal and the ventral.

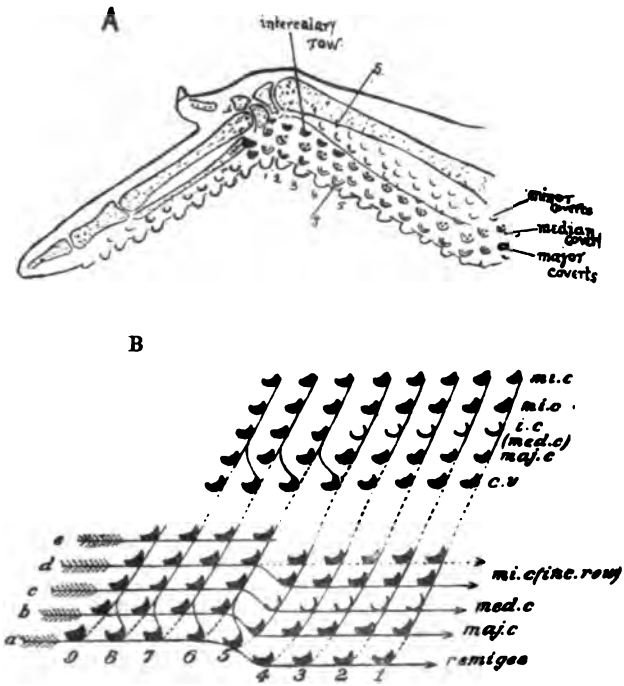

Fig. 5.

A. The upper surface of the left wing of an embryo Lapwing *(Vanellus cristatus)*, showing the disposition of the feather papillæ or rudiments of the future feathers. This is an example of a diastataxic or gap-winged form of wing, there being no remex between the fifth pair of major coverts in the adult. This figure shows that diastataxy has been brought about by a process of shifting of the remiges 1—4 and coverts 1—5 in each of the horizontal rows above remiges 1—4 Inasmuch as it has caused the fifth obliquely transverse run of coverts to come to lie between the remiges 4—5, and the sixth row of coverts to move forwards, or outwards, to occupy the position of the fifth, the seventh row of coverts to move forward to occupy the position of the sixth, and so on to the elbow-joint.

The lower figure (B) is a diagram indicating the way in which the eutaxic wing becomes diastataxic. The "intercalary" row is formed by the first row of minor coverts, not by the medium coverts, as indicated in the upper figure of this diagram.

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The fifth pair of coverts, however, embrace no remex. *Whenever we find the wing-coverts disturbed in the manner indicated, we always find it accompanied by the absence of a remex from between the fifth pair of major coverts.*

But the absence of the quill between these coverts is not *always* associated with a disturbance such as that indicated above, as witness the Parrots. Fig. 5 shows the nature of the arrangement in the diastataxic wing.

No explanation of this was forthcoming till recently, when the writer and Dr. P. Chalmers Mitchell were enabled to throw considerable light upon the subject.

Dr. Mitchell distinguishes those wings which lack a remex between the fifth pair of coverts as diastataxial, and those in which the wing is complete in this respect as eutaxial.

It was shown, by the writer, that, in the embryo, all wings are, at first, eutaxial; later some become diastataxial.

The eutaxial wing can best be studied in the 5—8 day chick. The feather papillæ in these stages can be seen with ease. They will be found to be arranged in quincunx, so that perfect feather rows can be traced in both horizontal and oblique directions.

The first feathers to appear are the remiges and the major coverts. In the early embryonic stages of the Plover, for instance, only these two rows are represented, and the wing is, furthermore, eutaxial. Simultaneously with the appearance of the rows in front of the major coverts, a process of shifting takes place. The nature and extent of this shifting is shown in Fig. 5 A, which represents a later stage of development than that described above. It will be seen that remiges 1—4 have moved slightly outwards, towards the tip of the wing, and, at the same time, backwards and downwards towards the under surface. Coverts 1—5 of the major, median, and minor coverts have moved likewise in the same directions. As a result, we have the "faulting" already described. This faulting accounts for (1) the presence of an "intercalary row" and (2) the mystery of the absence of a quill from between the fifth pair of major coverts.

The intercalary row is seen to be nothing more than the first five feathers of the first row of minor coverts, which by the backward

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faulting have become disassociated from the rest of the row, and serial with the median coverts from the sixth inwards. Similarly, the displaced median coverts 1—5 now lie more or less obviously, serial with the major coverts, from the sixth inwards.

By the descent of the feathers 1—5 of the second row of minor coverts to fill the place of the feathers forming the intercalary row, apparent order is restored, the arrangement of the coverts beyond being quite orderly, as will be seen by a reference to Fig. 4.

The wing of the embryo Guillemot is still more instructive, as, in this, the shifting does not take place till about hatching time. At any rate all, save perhaps the marginal coverts, have made their appearance in the shape of papillæ before there is any trace of shifting, the full extent of which cannot be appreciated till a comparison with the wing of the nestling is made, and this is completely diastataxic. The study of this wing seems to leave one no alternative but that the diastataxic is derived from the eutaxic condition.

So far we have described the covert feathers of the wing as running in horizontal series, parallel with the long axis of the wing, and for general purposes of convenience in describing external characters this may be done. In reality, however, it would seem that these coverts really run in transverse series, so that the sum of a series of transverse rows makes a horizontal row of major, median, or minor coverts, and so on, as the case may be, just as the sum of coloured rami of a feather make up the intricate pattern which is often present. Thus, in considering the shifting of the coverts, we may regard them as moving in horizontal rows or in transverse rows, the result will be the same; but it is important to remember the genetic relationship of the feathers in transverse rows.

This remarkable shifting of the transverse rows of coverts 1—5 explains the absence of a remex from between the fifth pair of major coverts, inasmuch as it seems to have thrown the whole arrangement between covert and quill out of gear from the fifth remex inwards; resulting, strange though it may appear, in the shifting forward, one place of the transverse rows of coverts from the sixth row inwards. As a result of this shifting, the sixth major covert row becomes attached to the fifth remex, the seventh major

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covert to the sixth remex, and so on to the innermost remex. Thus, the major coverts 1—4 become attached to the remiges which, in the embryonic wing, lie immediately behind them, and the major coverts from number six inwards are attached to the remiges immediately in front of them, leaving the fifth covert completely divorced from its original moorings. See Fig. 5.

Diastataxy is not a sporadic feature or confined to a few species, on the contrary, it is characteristic of many large groups of birds. For instance the Megapodes, Geese; Steganopodes—*e.g.*, Gannets, Cormorants, Frigate-birds; Storks, Herons; New World Vultures, Hawks, Eagles, and Old World Vultures; Cranes; Limicolæ—*e.g.*, Sand-pipers, Snipe, Curlews, Plovers; Pigeons; Petrels; Divers and Grebes; are all diastataxical. So also are the Parrots, Owls, Night-jars, and many Kingfishers and Swifts.

But there are some puzzling exceptions to this rule which were very baffling until it was shown by Dr. P. Chalmers Mitchell, that at least in many cases the supposed eutaxial discordant forms were really diastataxial. The groups of birds in which this pseudo-eutaxy has been proved are the Pigeons and Kingfishers. What obtains here probably explains the exceptions met with also among the Swifts, and certain aberrant members of the Gruidæ.

In studying these exceptions we must first of all notice that the process of shifting, which we have already described, brought about a distinct gap between the fourth and fifth remiges, a gap which, regarded in conjunction with the fact that the fifth pair of major coverts in such cases embraced no remex, lent colour to the view—that a remex was actually missing.

Within the limit of this gap, when normally developed, will be found a major, and on either side of it a median covert. In the apparently eutaxial Pigeons the gap has become reduced so as not to exceed the space dividing the remainder of the secondary remiges one from another. The two median coverts become markedly reduced, and finally, in some Pigeons, disappear altogether, whilst the major covert becomes so reduced as to give it a superficial appearance to one of the two missing median coverts. The wing thus appears to be eutaxial. Since, however, the dorsal and ventral major coverts still remain, the wing is, undoubtedly, diastataxic.

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What obtains amongst the Pigeons Dr. Chalmers Mitchell has more recently shown (5) obtains also among the Kingfishers. Moreover, in this group the conversion of the diasta- into the eutaxial wing is still more clearly shown. Amongst different species of the same genus, some are diasta-, some eutaxic. *Ceryle maxima*, for instance, is diastataxic, and retains all the coverts of the displaced remex; but *Ceryle inda* and *C. americana* are eutaxic, having eliminated the whole of the tell-tale transverse row of coverts. By the same process *Halcyon rufa* has also become eutaxic. If evidence be needed that this interpretation is correct, it may be obtained from the wing of *Halcyon pileata*, inasmuch as the last stages in the evolution of the eutaxial wing are here traceable in the three small feathers belonging to the minor coverts, which are all that now remain of the fifth transverse row. Hitherto no such completely transitional stages have been available. Their discovery is of great importance, since the presence of eutaxic wings in what may be described as diastataxic groups has long been a stumbling-block.

The question now very naturally arises: Which are we to regard as the more primitive arrangement, the diasta- or the eu-taxic? That one is a modification of the other there can be no doubt. Adopting the terms recently coined by Dr. Mitchell, I contend that the eutaxic is to be regarded as the archecentric condition, and that the diastataxic is a uniradial apocentricity thereof, which probably made its appearance at a very early period in the phylogeny of the class Aves, and possibly, together with the segmentation of the pterygoid, and the consequent changes in the arrangement of the palatine bones, to which I have lately drawn attention (11). If this be so, then we must regard the whole of the Neognathæ (Carinatæ) as diastataxic forms, many of which have once more become eutaxic, whilst others are in process of becoming so.

I base these conclusions largely, but not entirely, on the evidence obtainable from a study of the wings of embryos, feeling convinced that what appears during the ontogeny represents the phylogenetic history of the wing. That the embryological record may be falsified we all know; but cænogenetic changes are generally traceable to adaptation to the needs of the developing organism,

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and these are hardly likely to affect the growth and disposition of the feather papillae.

One is tempted, however, at times to adopt the alternate hypothesis that diastataxy is an archecentric character directly traceable to the proto-avian wing. Reflection, however, robs this of its fascination, for it seems hardly likely that, in spite of the profound changes which have taken place during the evolution of the wing, the position of the original reptilian scales, from which the feathers have been derived, should have been preserved. If we admit, as indeed we must admit, that a very considerable shifting has taken place since the development of the feathers, we are landed in a still greater difficulty, for we should have to suppose that in spite of shifting and suppression, the existing feathers represent what is left of the clothing of the ancestral reptilian limb, scale for scale, and that the diastataxic condition of the wings of modern birds is due to the absence of a single scale in the exact position indicated by the "missing" quill.

It seems to me more in accordance with the evidence to hold that the eutaxic wing represents the archecentric condition. Furthermore, it is probable that the primitive eutaxy is represented only in the wings of the Palæognathæ (Ratitæ)—*e.g.*, Rhea, Ostrich, and that the eutaxic wing of modern birds is a secondarily acquired character—a reversion to the primitive character—wherever it is met with.

As further evidence, I venture to suggest that the presence of the feathers known as the carpal-covert, and remex may have some significance, inasmuch as since these feathers—representing a degenerate remex and its major covert—are found in the wings of both eu- and diastataxic forms among the Neognathæ, they are, probably, in some way associated with the origin of diastataxy, or in other words, with the origin of the Neognathine avian wing; for it must be remembered, it is here suggested that the eutaxy of the Neognathæ is a pseudocentric character.

For clearness sake, I have omitted the discussion of many other features in the pterylography of the wing in order that I might give the more prominence to the question of the origin and meaning of diastataxy. The causes which gave rise to this remarkable phenomenon are yet enshrouded in mystery. I commend the matter to the members of the Society.

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V.

THE GREAT BUSTARD IN NORFOLK.

By Thomas Southwell, F.Z.S., V.-P.

Read 26th November, 1901.

In the Report of the Historical Manuscripts Commission, Duke of Portland's MSS. vol. vi. (1901) page 164, is printed "An account of a journey made through part of the Counties of Suffolk, Norfolk, and Cambridgeshire, in the month of September, 1732," the original manuscript of which is in the hand-writing of Edward Harley, the second Earl of Oxford (1689-1741), and which contains the following passage under the date of September 20th, 1732.

Page 164. "From Narford we did intend to have gone by Swaffham, but we were advised to keep the middle way, which we did, and came to a place called Cley, five very long miles. The Duke of Montrose has a house here which he hires of Mr. Dashwood. The ground seems very poor, an open country. Before we came to Cley we saw on the right hand a herd of Bustards, about nine or ten. I never saw any alive in the fields, these large birds always delighting in champaign countries, because they are heavy and their wings but short, that it is a long time before they can get upon the wing; they run a long time before they mount, they are often catched with Greyhounds before they can get from the ground. If they were not in an open country they would soon be destroyed, having no way to avoid their enemies in enclosures, but where they are open, and upon their guard, but that does not save them. They are esteemed a rarity and must be had; if all were of my taste they would be unmolested, and die natural deaths."

In addition to the casual interest which is attached to every mention of this grand bird as a native of Norfolk, there are some circumstances connected with the above record to which I should

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like to call attention; and one of these is the season at which the birds were seen. Whether the indigenous race was with us a regular migrant, as is the case on the Continent, is one of the points in the life history of the species which has not been satisfactorily determined; but that the adult male birds separated themselves from the breeding females at the commencement of summer there can be no doubt. Mr. Hamond, writing to Selby, states that the sexes were never seen together at that time of year; but what then became of them was not known, nor was it clearly ascertained whether in this country they were polygamous or not. At no time were the numbers of the two sexes at all equal, the females being, apparently, largely in excess of the males; I say apparently, for the males, until they became fully adult, would probably not be readily distinguished from the females. On arriving at maturity, however, they would, from their superior size, be very conspicuous, and for the same reason be more likely to be victimised for specimens. About the end of harvest they became very scarce; both sexes, however, appeared again in winter to feed in the turnip fields. Mr. Hamond, in the letter to Selby before quoted, says that he was certain to be able to show the latter a Bustard in winter, if not in summer.

Mr. Stevenson, remarking upon the apparent absence of these birds from the middle of September to Christmas, which included a great part of the shooting season, when they would hardly have escaped observation, states that "there is positively no precise information respecting the appearance of a Bustard during the months of October and November." Such being the case, the late date on which the "drove" was seen by Lord Oxford, namely September 20th, becomes of interest. I may add other instances of the occurrence of Bustards in September—two mentioned in the Holkham game book as killed on the 7th, one taken in a rabbit trap at Elveden on the 27th, and one on Salisbury Plain on the 29th of that month. Of the two months during which they were supposed to be absent, on October 7th, 1814, one was killed at Holkham, and, according to the same authority (the Holkham game book), on the 11th of November, 1816, "a wild day," Lord Spencer saw three Bustards—these latter occurrences were not known to Mr. Stevenson.

There are some winter examples which I think must be regarded as doubtful natives, especially those subsequent to the year 1838,

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when the last of the indigenous race is believed to have been killed.

It will be noticed that Lord Oxford repeats the popular fiction with regard to the supposed hunting of Bustards with Greyhounds. What gave rise to this curious fable, so frequently repeated, it is difficult to imagine, unless it were some accidental capture of the kind under altogether exceptional circumstances; but his lordship only repeats an oft-told tale, and adds nothing from his personal experience of this bird, which, in a state of nature, according to his own statement, was confined to the instance here related; but his concluding remark, although uttered a hundred years before its fulfilment, was prophetic of the fate of these magnificent birds: "they were esteemed a rarity and must be had."

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VI.

ACULEATE-HYMENOPTERA AT TOSTOCK, NEAR BURY ST. EDMUNDS.

By W. H. Tuck.

Read 26th November, 1901.

The brilliant weather which the first summer of the new century gave us afforded ample scope for field work, but as an entomological season it was not an extraordinary one for rare captures, with one exception, which I will refer to later.

Although I have no new captures to record among the Aculeate-Hymenoptera, I found several interesting insects.

On Bungay Common—a good centre—the rare bee Anthophora retusa was abundant in early June; but I failed to obtain its parasite, Melecta luctuosa. This Bee is, apparently, getting extinct; the common M. armata being found with both species of Anthophora.

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In July, near home, I found a large colony of Mimesa equestris in a sandy rabbit-hole. This singular insect is not uncommon upon Mousehold, and Wortham Ling near the Butts, the only other localities I know of for it. I spent several days at Brundall searching for the late Mr. Bridgman's rare Bee, Macropis; but since the Acle line was made this spot is much altered, and I fear the Bee is, in Norfolk, extinct. It swarms in Wicken Fen; breeding, I believe, in a grassy path leading from Wicken to Upware.

The Hornet was rather numerous in Suffolk, and I obtained a fine nest built in a pigeon-locker. This hung upon the wall of a cottage facing east, and during two days of easterly wind at the end of August, the curious "wind-guard," or covering, which the Hornets made over the entrance hole to keep out the light, was blown in and never repaired. The Hornets, however, continued to enter by a small hole at the top, and I found the nest deserted on October 18th, an early date. It is now in the Ipswich Museum.

Early in August I found a strong colony of the rare Vespa rufa in a mole-run just beneath the grass within thirty yards of my window. This is a very docile Wasp, and I brought the nest indoors on August 19th, and watched them for nearly three weeks in my glass hive in the hope of getting the rare parasitic Wasp, V. Austriaca, which lives with them. But although several of the males had one or more of the typical marks of Austriaca,—the yellow scape to the antennæ, and the black hairs on the tibiæ, the *double* marks did not occur upon the same Wasp; and Mr. E. Saunders, who saw many of them, believes that Austriaca is only to be found in the North and West of England and in Ireland. But if any one will watch a nest of V. rufa from about the middle of July (it being an early Wasp) the parasite might some day be found.

Sawflies were very scarce, the only one of note I took was a male, Athalia spinarum ("black jack"), from a Tamarisk bush at Aldeburgh. I never took the female, which has the thorax yellow, and appears in May—the autumn brood appears to be chiefly males.

When at Bungay I took the following Diptera: Oxycera trilineata, Beris clavipes, and Dysmachus trigonus; and at Aldeburgh by the Mere, Nemotelus uliginosus, and Platychirus

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angustatus; and at Tostock, Trigonometopus frontalis, with Ptycoptera albimana, all new to my list.

In Coleoptera, my best capture was Hedobia imperialis, which came on the window in May. At Brundall, in August, I took the curious Weevil, Cionus scrophulariæ flying in the sunshine near Dr. Beverley's lake; and on the marshes at Aldeburgh, Sitones puncticollis, Zeugophora subspinosa, and Chilocorus bipustulatus. Late in September, at home, Cryptophagus populi from a fungus on white Poplar. This is a very rare insect, and new to the Suffolk list, and not recorded in Norfolk, I believe, since Stevens found it in the thirties.

The hot weather caused many of our numerous ponds to be very low, and several were quite dry. I took the opportunity in September and October of dredging for water insects, which had collected together and were easy to get at. Although so late in the season, I got both sexes of Dytiscus marginalis in plenty: Colymbetes fuscus, Haliphus fulvus, Ilybius fenestralis, and Pelobius tardus. And among the water-bugs: Naucoris cimicoides, Corixa geoffroyi, and the curious and rare Ranatra linearis, a stick-like creature, three inches long, which lives at the bottom of the ponds. Among the Hemiptera and other land-bugs, the marshes at Aldeburgh yielded Anthocoris confusus, Paramesus nervosus, Idiocerus distinguendus, Athysanus sordidus, Teratocoris antennatus, and by Plumstead lake, Phytocoris longipennis.

The great event of the year was, undoubtedly, the phenomenal appearance of the larvæ of Sphinx convolvuli. Large numbers were found in Essex, Suffolk, and Cambridgeshire, generally upon the wild Bind-weed, or Lesser Convolvulus, in Potato fields, and sometimes upon the Scarlet Runner-bean. Several newly hatched Moths were brought me, which had flown into light in the cottages; but the natural condition of the pupæ, which are subject to the autumn rains and dews, is nearly always affected by trying to breed the Moths indoors, unless the pupæ are "forced" in a warm temperature, and I have heard of a few Moths being successfully reared in this way. Many of the pupæ of course will be struck by Ichneumons, which may emerge in June, and I should be very grateful for a specimen bred from the pupa of *Convolvuli*, which once seen cannot be mistaken for any other of the Hawk Moths.

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VII.

LIPARIS LOESELII, AND *TEUCRIUM SCORDIUM* IN ENGLAND.

By Arthur Bennett, F.L.S.

Read 21st January, 1902.

Following up the notices of *Senecio paludosus* and *S. palustris*, that I had the honour of sending the Society on February 28th, 1899, and published in the 'Transactions' (vol. vi. p. 457, 1899), I now give some Notes on two other East Anglian plants, the first so confined, but the latter occurring in other counties. I shall be much obliged for any additions to these Notes, as I am anxious to acquire as far as possible materials for the history of our rare and decreasing species; for such they must become as enclosures, drainage, and cultivation extend. I send specimens for the acceptance of any member of both plants.

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Ophrys Loeselii. Linn. Sp. pl. ed. 1, 947, 1753.

Orchis lilifolius minor sabuletorum Zelandiæ et Bataviæ. Ray. Cat. Plant. circa Cantab. nascentium. 1660, p. 106.

It appears under six other names in various European Floras, but the above are used in English books.

I have not been able as yet to find any real English name for this plant, the nearest being that given to me by a native of Soham, Cambs. He called it 'Fen Orchis.' The names given to it in English Books are:—

1. Dwarf Orchises of Zeeland, or rather Marsh bastard Orchises. Ray in Camden.

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2. Dwarf Ophrys. Hudson Fl. Angl. ed. 3, p. 390, 1798.

3. Two-leaved Bog Orchis. Smith, Eng. Fl., vol. iv. p. 48, 1828.

4. Dwarf Twayblade. Withering Arrang. Brit. Plants, ed. 7, 2, p. 40, 1830.

5. Bulbous Twayblade. Loesel's Dwarf Orchis. Gray, Nat. Arrang. Brit. Plants, 213, 1821.

6. Two-leaved Liparis. Hook and Arnt. Brit. Fl., ed. 6, p. 427, 1860.

7. Fen-Orchis. Syme, Eng Bot., ed. 3, 9, p. 134, 1869.

In England it has occurred in West Suffolk, East Norfolk, Cambridgeshire, and Hunts, also reported from Kent, and it probably occurred in Lincolnshire.

15. Kent East.—Boggy ground about Ham ponds, near Eastry. Dillwyn, Bot. Guide, 356, 1805. Fl. Kent, 324, 1899.

26. Suffolk West.—Lakenheath, Henslow and Skepper, Fl. Suff., 83, 1860.

Bogs at Tuddenham. Sir T. G. Cullum, Bot. Guide, 564, 1805; J. Duthie, 21, 7, 71!

Lopham Fen. Miss Barnard, 1857; Mr. Gissing, 1860.

Redgrave Fen. C. J. Ashfield, Phyt. N. S., 323, 1861; Rev. Hind, 1883.

Thelnetham Fen. Rev. Hind, 1883, sp.

27. Norfolk East.—(Roydon Fen) near Diss. Woodward in Bot. Guide, 444, 1805. Kirkley, 1835, in herb., J. A. Power (Reigate!); Sir J. E. Frerè, sp. in herb., Bennett, 1876; H. D. Geldart, 1901. Ranworth in two places. Preston, 2, 7, 1882. Hanbury and Holmes, 1883! Hanbury and A. Bennett, 1884, in great quantities, and bearing seed vessels in some cases of two years before, going with *Carex stricta* and *C. paradoxa*. C. E. Salmon and A. Bennett, 1900. H. T. Mennell, Aug. 1885! the second locality. Thurne, Rev. C. Davie; Geldart, Trans. Norfolk and Norwich Nat. Soc. v., 109, 1889. C. E. Salmon and A. Bennett, 2, 8, 1900. St. Faith's Newton Bogs, Mr. Pitchford, one specimen in 1767. Mr. Crowe, three specimens in 1788.

28. Norfolk West.—I can find no record for this.

29. Cambridgeshire.—Hinton! Teversham, Fulbourn! and Sawston Moors, Relham. Fl. Cantab. ed. 3, p. 363, 1820.

Near Cambridge, Lightfoot, in herb., sold by Lake of Uxbridge.

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Wicken Fen, Power, 1836; Eaton and Fox, 1862; A. Wilton, 1880; T. H. Burkhill, 1896; Rev. H. H. Slater, 1901, sp. in herb., Bennett.

Burrell Fen, Henslow, 1833! Power, 1835.

Bottisham Fen, Henslow.

Fordham Fen, A. Fryer, sp. 8, 9, 1883.

Chippenham Moor, A. Fryer and A. Bennett, July, 1884; in abundance in fruit.

It was seen in these last two localities by Mr. W. West, Jun., in 1896.

Gamlingay Bogs, John Power (no date) in Holmsdale (Reigate) Nat. Hist. Soc. Herbarium as "Ophrys Loeselii."

It is extraordinary that Prof. Babington did not mention this locality in his Flora of Cambridge; that it was known is certain, as in the 'Phytologist,' 612, 1847, Mr. C. Prentice remarks, "The destruction of Gamlingay bogs has taken away one of the best localities of this curious and rare plant, as well as for several others." There can have been no confusion with Malaxis, as Dr. Power's herbarium contains specimens of *Malaxis paludosa*, labelled "Gamlingay bogs, July, 1883," in the handwriting of Dr. S. A. Power; and Babington mentions Power in his Journal; and this makes it the more remarkable that he does not give it.

31. HUNTINGDONSHIRE.—Stilton and Yaxley Fens, Rev. Bree, in herb., Watson! 1841, 1840.

I know of no record since, and these fens are now drained.

Whittlesea Mere, Rev. M. J. Berkley in Watson's Cyb. Britt. 2, 438, 1849. In 1850 the water finally left the bed of Whittlesea Mere dry.* In 1860 the bed had sunk 3½ feet; in 1875 8 feet 2 inches, and splendid crops of corn were growing where Water Lilies and Wild Ducks formerly existed (*l.c.* p. 89). Lincoln.

F. W. Burbridge in 'Gardener's Chronicle,' 144, 1884. Rev. Woodruffe Peacock, in Crit. Cat. Lincoln Plants, 246, 1896, in 'Naturalist.' Mr. Burbridge wrote to Mr. W. Peacock, "Some years ago a lady who was quite a stranger to me, sent a specimen of *Liparis loeselii* in flower, growing among a tuft of rushes. I remember her note and specimen came from Lincoln (City). I have often since regretted that I did not ask where it grew, and I also wish I had preserved the specimen."

* J. M. Heathcote, 'Fen and Mere,' p. 78, 1876.

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This seems to me rather weak evidence on which to certainly admit it as a Lincolnshire species, though I have myself little doubt that it grew in the East and West Fens before they were drained.

According to Mr. Clarke's "First Records of Brit. Fl. Plants, ed. 2, 134, 1900," it was first recorded by Ray in his Catalogus circa Cantabrigensis nascent. 106, 1660. In Europe it occurs in: Sweden, Denmark, Norway, Belgium, Holland, Germany, France, Switzerland, Tyrol, Lombardy, Austria, Hungary, Russia mid. and south. North America, Canada! United States! From dates I have accumulated it seems to occur in abundance in cycles of about twenty years.

The specimens I gathered at Ranworth are the largest I have seen of the species; two or three of them measure 9½ inches in height, and one from Chippenham in good fruit measures 9 inches. Syme in 'English Botany,' 3 ed. vol. ix., p. 134, says "stem 3 to 8 inches high." The majority of British specimens I have gathered and seen come between 3 and 6 inches in height; and this is the range that Bentham gives in his 1858 Flora.

TEUCRIUM SCORDIUM, Linn. English names: Marsh Germander, Water Germander, Water Calamint, Scordium, 534, 1 and 2. Catalogus Hortii. Joh. Gerardi, 1599. Garlicke Germander. In England this plant has become very rare in many counties, but is still fairly plentiful in Devon and in Ireland.

It occurs in the following counties:—

4. DEVON NORTH.—Lord Courteney's Park; Braunton Burroughs (Burrows). Polehele Hist. of Devon. 1863! 1876! 1884!

22. BERKS.—Meadow called Nietford (St. Neot's Meadow) Richard Slater, Gerarde Herbal, 535, 1597. Sp. in Herb. Brit. Museum! Refound by Mr. Druce, Sept. 1900.

23. OXFORD.—Groweth near to Oxenforde on both sides of the water. Gerarde, 1597.

Near Aristolte's Well at Oxford, Merrett, 1666. Upon Botley Causeway . . . . nigh Oxney Hill, &c., Mr. Cole, 1657. Banks of the Isis at Highbridge; Eynsham Common Sibthorp. Godstow, very rare, sp. H. Boswell in Herb. Brit. Museum!; 1597, 1657, 1780. Mr. Druce has been unable to find it. Fl. Oxford, 224, 1886.

26. SUFFOLK WEST.—Lakenheath, very rare; Henslow and Skepper, Fl. Suffolk, 68, 1860. Hind, Fl. Suffolk, 278, 1889. Searched for in recent years unsuccessfully.

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27. Norfolk East.—Horning, R. Wigham, in copy of Fl. Brittanica. K. Trimmer, Fl. Norfolk, 114, 1866.

28. Norfolk West.—A single sp. at Stow Bridge by Miss Bell. Rev. G. Munford, Fl. pl. of West Norfolk. Ann. and Mag. Nat. History, viii. 71, 1841.

Welney Delph. Salmon herb. at Norwich, teste Linton in Jour. of Botany, 268, 1900. Will probably be refound about this locality.

29. Cambridgeshire.—Osier-holts about Ely City. Ray in Gibson's ed. of 'Camden's Brittanica,' 1695, "besides these there grow large quantities of Scordium or Water Germander upon the banks of ditches," *l.c.* Ely, 1822, Winch herb.! W. Marshall, sp. 1875. W. Cross, sp. 1880.

Ditch, Cambridge to Histon, Waterbeach, Cottenham, Relhan, Fl. Camb., ed. 3, 232, 1820. Kings Hedges, Babington, Fl. Camb., 185, 1860. J. A. Power, 1835, sp. in Holmsdale Nat. H. Club, herb. Not seen at other stations for years.

Mepal; Henslow.

Pits at Horseway, Chatteris, Sept. 1879. A. Fryer, sp. (extinct).

Ditch, Sutton Gault to W. Fen Drove, Sept. 1900 (extinct).

Ditch, near Sutton Gault on the Ely side. A. Fryer and A. Bennett. In great abundance here, hundreds of specimens might have been gathered.

32. Northampton.—In some ditches on the borders of the Fens. Morton in Bot. Guide, 463, 1805. Extinct. Druce in Jour. of Botany, 373, 1886.

53. Lincoln South.—Washingburgh Fen, 1870. F. A. Lees in 'White's Directory of Lincoln,' 1892.

54. Lincoln North.—In the East Fen, often near the places where Geese frequently land. Sir J. Banks in Bot. Guide, 389, 1805. Sp. in his herb. at Brit. Museum! First record in Lincoln by Arthur Young in 1799. The East, West and Wildmore Fens have long been drained.

65. York N.W.—Bolton-on-Swale near Richmond, R. Bowman, New Bot. Guide, 259, 1835, H. Ibbotson, sp. 4, 8, 1854. Mr. Wilkinson tells me it has not been gathered he believes for twenty-five years. It was gathered about 1850 by J. Ward (H. T. Mennell, herb.). Potteric Cans, E. Miller, in Hist. and Antiq. of Doncaster, 1804. Lees' Fl. W. Yorkshire, 364, 1888. Never confirmed.

In Ireland it occurs in the counties of Tipperary, S. E. Galway,

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Westmeath, Longford, Roscommon, and Leitrim. R. Praeger in Irish Top. Botany, 1901.

It has also been reported for the following counties in England: *i.e.*, "Surrey, Kent, Chester, Lancashire, and Bedford." Watson Out. of Brit. Plants, 1832. If ever found in these, it has not been recorded since 1835.

Dist. in Europe.

Denmark, Sweden, Germany, Holland, Belgium, France, Italy, Switzerland, Austria, Hungary, Montenegro and adjacent countries. Mid. and S. Russia, N. and W. Asia, N.W. Himalayas, North Africa.

It is now to be found probably in Devon! Cambs! Berks, W. Norfolk? and M.W. York? in England.

In the 1st ed. of his Manual of Brit. Botany, 237, 1843, Prof. Babington gives *T. scordiodes*, Schreber, as occurring in Devon and Cambs; in the 2nd ed. 253, 1847, he says, "it is only a state caused by situation," a result arrived at by Dr. D. Moore, in the 'Phytologist,' 2, 129, 1845. The true *T. scordiodes*, Schreb., occurs in Portugal, Spain, France, Italy, Turkey, Greece, and S. Russia.

I hoped to have searched at Welney last August when at Ely, but was unfortunately called home before I could do so; but trust to do so some time, or induce my keen friend, Alfred Fryer of Chatteris, to do so. First record in England,—teste Clarke *l.c.* "I heare say that it groweth . . . . beyonde Oxenforde," Turner, Names G. j. back. 1548.

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JOHN THOMAS.

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VIII.

JOHN THOMAS, PUNT-GUNNER.

By A. Patterson.

Read 28th January, 1902.

Much has been written of late about the Broads and their inhabitants, and the theme was a worthy one, for both the country and the dwellers therein, before the advent of "'Arry and 'Arryat" were, *sui generis*. Interviews with "broadmen," too, are common enough, and under the genial influence of unlimited use of the stranger's tobacco-pouch and the cup that cheers, wonderful have been their narratives, which, freely interlarded with the vernacular, presented a very genuine appearance. "Well 'bor he wor a werry nice gen'elman sure-ly, and I did my best to plaise him, but——," and the merry twinkle of his bright grey eye under its heavy brow was amusing to the initiated, for the broadman although so stolid in appearance has a keen sense of humour; but what matter, the interviewer has gone away with a good batch of "copy" and all were pleased. It is not thus, however, that these men are to be successfully approached, and if the reader would like to know what the Broads and their inhabitants really were like in the past he must turn to authorities long antecedent to the advent of the gentlemen who, in blushing silence, accept the honour of having been their discoverers. And happily we have such in the writings of certain old sportsmen-naturalists who lived in the first four decades of the past century, such as Girdlestone, the Pagets, and above all Richard Lubbock. Of course all this is pre-historic to the "discoverers" we have just been referring to, but a perusal of the Introduction to the Second Edition of the 'Fauna of Norfolk,' by the last-named gentleman, will richly repay the reader, for there will be found gathered together many sketches, slight but graphic,

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of a race of men, their ways and appliances, who have all passed away, and with regard to the descendants of some of whom from a life-long personal acquaintance, I should like, before it is too late, to put on record some particulars.

On the present occasion I will restrict myself to one whose name is at the head of this article, but I hope on some other occasion to give my experience of others.

On the 1st of March, 1901, died "Lucky" John Thomas, better known amongst the fraternity of local sportsmen as "Pintail," the last of a long line of Breydon wild-fowlers, and the third bearing that Christian name. How many predecessors in the family of similar occupation there were it is impossible to say, but certain it is that he was the last of his race, and it may also be said that with his demise passes into oblivion the last of the professional punt-gunners who have, like Othello, found their occupation gone, for what the drainage of the surrounding lowlands, the "growing up" of Breydon, the increased traffic, and other altered conditions did not effect, the Close Season and the Bird Protection Acts have effectually accomplished.

It must be remembered that prior to protection being afforded to the spring migrants, shooting went on all the year round, and many of our rarest birds were obtained at a season, to take advantage of which to-day would be judged a misdemeanour. What a number of Spoonbills might, even of late years, have been slain but for protection! So it will be seen that even with the enhanced value of rare specimens, it is impossible to gain a livelihood to-day with punt and shoulder-gun. Yet an occasional hard winter makes shooting profitable while the severity of the weather lasts, and something like the old times reminds us of those palmy days of wild-fowling, and the poulterer's stalls again creak with the weight of the slain. There are still a few punt-guns, but these are used more for pleasure than for profit.

John's grandfather is especially mentioned by the Messrs. Paget in their 'Sketch of the Natural History of Great Yarmouth' (see page ix), where they refer to "an old man named Thomas, who, one morning on awaking in his boat on the flats, saw not far from him a number of Wild-fowl sitting in a crowd close together on the ice. From the boat being nearly covered with snow, he had escaped their observation, while they were collecting in the night. He

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immediately fired, (his gun carrying about a pound of shot), and with those killed outright and the wounded, which he and his dog caught before they could make their escape, he secured no less than thirty couple of Wild-fowl, consisting principally of Widgeon and Teal."

And John's immediate progenitor is still remembered by the older and worn-out gunners as a man whose exploits are worthy of mention. He was the subject of many adventures, and a fondness of rum led him into several mishaps. It was not unusual for him to spend a merry, unwise night, and instead of returning home, tumble into his gun-punt, and by some means propel her up Breydon, where, making her fast to a stake, he would fall asleep, to wake up more or less sobered. On one occasion waking up under similar circumstances to those just related of his father, he found himself surrounded with ice, a "wake" opening up before and behind him being filled with Wild-fowl. The sight immediately brought together his remaining senses, and he "blazed away at the fowl," to use the words of my informant, securing quite a heap, "which he piled on the ice," as successive shots added to the number of his victims. John's father lived to be an old man, and like the subject of our sketch retired to rest in the Fisherman's Hospital, where, however, he was not destined to pass quietly away, for one fatal night, on going up Breydon with a companion, having already made too free with spirituous liquors, they made the sheet fast while still imbibing, and the boat upset, Thomas sinking almost immediately. The other man was rescued, but it is notorious as being characteristic of the men of the period, his first expression of regret was that "a bottle of beer had gone down in the boat." One adventure of his is worth recording. He had left his punt and gun moored by the river-side, when some urchin rammed a stone down the barrel. On firing the gun the barrel burst, a large hole being made in the bottom of the punt by a piece of iron, but he managed to keep afloat and brought the boat home.

The subject of the present sketch was also the sport of many mishaps despite his nickname, for he was "Lucky" more by accident than by any successes achieved through superior sportsmanship, or the faculty of self-preservation. On one occasion he lent his boat and gun, the latter being returned to him loaded. With characteristic carelessness he placed a second charge over the first

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with the result that the next discharge of the weapon not only blew the fowl to pieces, but knocked "Johnny" senseless into the after-part of the boat, breaking his collar-bone. Once again, a shoulder-gun which should long before have been superannuated, burst as he fired it, blowing two fingers to pieces. His greatest concern seemed to centre on the birds more than upon his fingers hanging by shreds of skin to the stumps.

As I knew him, Thomas's mutilated hand, encased in a sort of woollen "hutkin," was often racked by excruciating twinges of rheumatism; his not unpleasant features were scarred by powder burns, and his legs tormented often by gout, a complaint by no means ameliorated by the old man's love of the "sma' wee drap," that had so often brought on trouble in times gone by. Thomas had many narrow escapes. Whilst lying with his fishing-boat in Shields Harbour, when a young man, he fell mast-length to the deck, the tide having fallen low, but tumbled in a heap on the deck uninjured. Most men would have been killed by the fall, assuredly so had they been sober. Again at Lowestoft, in more recent years, whilst walking along the platform near the Basin, he mistook the reflection of the water for the pathway, and fell in. He managed to cling to the piles and seaweed, and was at length found exhausted, and dragged out all but dead. I had only that same morning treated him to a short temperance homily before leaving Yarmouth. A broken leg may be added to his numerous mishaps; and on another occasion he fell off a 'bus and broke his ankle when going to his boat.

It is a most marvellous fact that John Thomas died a natural death, for he was most reckless in his management of a fowling-piece, and used on occasion most atrocious weapons; when expostulated with he would declare that "they'd last him his life-time." He, at one time, used an ancient punt-gun, the lock of which was much worn, and the trigger so weak in its action, that it required two or three pulls in order to crack the patch; failing this, a piece of iron—part of an old swivel's "knee"—was brought into use as a hammer, and the charge exploded by this means. It goes without saying, birds chance time profited by this cumbersome procedure. Incidentally it may be remarked, many bad guns were in use in the earlier part of the last century; one man actually pulled a string in order to bring the cock down on the cap, the

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trigger having been lost. I myself knew a shooter whose gun-barrel and stock were spliced together with waxed cord. Another carried a double-barrelled gun, only one barrel of which was used, the other having a hole half way up it that the pellets might have trickled through. In comparatively recent years, a punt-gun was used on Breydon, with an extra length welded on the muzzle end. A borrower, not knowing this weakness, fired an extra heavy charge, with the result of a great scare to himself, and an explosion at the joint, the end "tubing" being thrown far away into the water, whence it was some months subsequently fished by a man picking for Eels.

Of course, in the halcyon days of shooting, John made some great shots; and his shop-front, on Fuller's Hill, would be festooned by rows of Wild-fowl, and when better birds were scarce, Gulls often adorned his hooks. I remember (I believe it was in 1881) his killing five Swans, two of which were shot with the punt-gun. These he let lay as they fell, hoping the three that had escaped would return for their companions; this they did, with the result that he killed them also with his shoulder-gun. Having hung them conspicuously in front of his establishment, Thomas proudly paraded before them, but on his attention being called to the fact of their being *tame* ones, they departed, like magic, from their prominent positions into oblivion. As a lad I recollect the big dishes and fruit trays filled with Dunlins, Ringed Plovers, Knots, Turnstones, Terns, Plovers, and the like, that were exposed for sale in the window. I once saw the shop smothered with small Waders. He had that day secured considerably over a hundred Dunlins at one shot; others brought him many dozens more; these all lay in order, row upon row on fruit trays. That night, with heads under wing, neatly and carefully stowed by the "missus" and the older girls, twenty-one dozen were despatched in hampers to Norwich, twenty-one dozen to Bath, and an equal number to London. The family all helped, and two daughters and the wife took especial interest in the birds; one daughter, who had a keener discernment than all the rest was "told off," if need be, to sort and identify the various species, with a view to the detection of any rarity amongst the common herd.

Why John Thomas secured in his day so many rare birds and good specimens was because he was most always on Breydon. Chance yachting trips enforced occasional absences, but directly he

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obtained his liberty, he was amongst his beloved Breydon flats again; in spring and summer, autumn and winter, he followed the migrants dropping in to feed, and to rest, in their season, so that it stands to reason they not infrequently came within range of his gun. Amongst the many birds slain by him may be mentioned the Black Stork (now in Norwich Museum), the Mediterannean Yellow-legged Herring Gull (in Mr. Connop's Collection), several Spoonbills, Avocets, the Temminck's Stint, and others. Every little parcel of "Stints" was eagerly examined through his brass-bare binoculars, in quest of "Alexandrine Plovers" (Kentish Plovers), and "Pigmys," and other less common species. He sometimes made good prices, now and then others reaped the benefit of his wild-fowling more tangibly than he did.

Thomas made no profession of religion, yet, strangely enough, made it a rule to regard the Sabbath, and refrained from shooting on that day. But his walks with the wife and children would, somehow, instinctively lead him Breydonwards. On one Sabbath evening they were all in Sunday best strolling along the South Breydon-Walls, when Mrs. Thomas, who was scanning the flats with a pair of field-glasses, suddenly placed them in her husband's hands, asking him what certain white objects on a mudflat in the distance might be.

"Spoonbills by G—— !" ejaculated Thomas, who immediately retraced his steps to the boat-house, Sunday notwithstanding, and throwing his hat and coat to the children, he slipped on his Breydon "togs," and pushed off. At one shot he killed two Spoonbills, which, being Close Season (it was in the early days of the Protection Acts), were safely smuggled home under his wife's shawl.

Mrs. Thomas aided and abetted her lord and master in his shooting delinquencies. It was not an unfrequent thing to see her sitting on the punt's stern of a summer's evening, "Johnny" rowing her in a steady purposeful manner. We Breydon-frequenters noted these goings to and fro, and sometimes twitted him, when he invariably retorted he was "taking the old woman just for a blow," but we knew that the "blow" was only a secondary matter, and that somewhere, in safe hiding from the wall-rats and prying eyes, was carefully stowed away some rare or valuable avine stranger, whose worth made profitable a second voyage to retrieve it. No one saw the process, but by some sleight of hand the bird would be

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transferred to a specially made pocket, somewhere in the labyrinth of petticoats, and brought home in safety.

In his youth, Thomas drifted naturally into the wild life on Breydon; his ancestors were wild-fowlers proper, who varied that occupation, according to the season, by Smelting, Mulleting, Eel-picking, and such like, the gun, however, always taking pre-eminence; and a shoulder-gun invariably had its place in the boat on whatever quest. Thomas once described to me how they filled his father's boat with Grey Mullet; "that was before the flats grew up so," he was always emphatic in mentioning; and to this silting up of Breydon flats, more than to any other assignable cause, he declared the falling off in the number of Wild-fowl was due.* Thomas's store of anecdote was a large one, and it is to be regretted that many of his yarns are not preserved to us.

But the hard life of constant exposure, with an insufficient care over himself, added to a succession of accidents, told at length upon Thomas's iron constitution; and after some years of intermittent suffering from rheumatism and gout, at seventy-two he lay on his death-bed the mere wreck of a man. I visited him several times during his last illness, when he seemed to bear his cruel pains with remarkable patience. A chat on old times, his favourite theme, would bring back some of the old man's enthusiasm. A day or two before he died I went to have a last chat with him, but he was beyond conversation. Laying on the side of the bed he prayed for that dissolution which in due course comes to us all, but which in his case seemed woefully long in coming, though wistfully welcomed. And so passed away, at seventy-two years of age, the last of the professional local wild-fowlers.

* I have, for some time past, been gathering the opinions of various Breydoners on this matter; they have, invariably, laid the fault to the construction of the "dickey works" throwing the water into the channel at the Burgh end, and the annual increase of the "wigeon grass" (Potamogeton), collecting the flotsam coming up-stream, and the silt coming down on the ebb.

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IX.

ON THE SILVER THAW AND GLAZED FROST OBSERVED AT KING'S LYNN, 20-21st DECEMBER, 1901.

By C. B. Plowright, M.D.

Read 28th January, 1902.

The phenomenon of a glazed frost was well observed at King's Lynn and its neighbourhood, on 20th and 21st December, 1901. For three or four days preceding Friday, 20th December, we had a succession of frosty nights, and more or less sunny days without either snow or any appreciable amount of rime frost. The roads in the country were frozen hard, but they were perfectly dry, free from ice, and not in the least degree slippery. On the afternoon of the 20th I drove through the village of Castle Rising, reaching home about half-past four; the roads were then hard and good, and the horse did not require roughing. Soon after this a gentle damp wind sprang up from the south-west. About six o'clock I had occasion to walk a short distance in the town, when to my surprise I found the streets had become so slippery as to be dangerous for ordinary pedestrians. Not only were the pavements extremely slippery, but the roadways were even worse, whether paved with granite cubes or macadamised. A little later a gentle rain began to fall which rendered the silver thaw more noticeable still. The suddenness with which the hard dry roads became almost impassable sheets of ice astonished every one; the change taking place within an hour, probably in half that time, and this too before any rain actually fell. The drivers of vehicles did not realise the state of the roads in the dusk until their horses slipped and fell. People who drove into Lynn from the country during the afternoon found that they could not return without having their horses roughed. The macadamised roads were far worse than those streets paved with granite setts or rounded pebbles. One of our main

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streets (High Street) has within the last year or two had its granite-cube pavement replaced by asphalt; this is apt at times to be so slippery that many persons driving valuable horses avoid passing down it. Curiously enough this street was the least slippery in the whole town. On the Gaywood road the silver thaw was very well developed; between Gaywood corner and the East Gates, a distance of about half-a-mile, eleven horses fell during the evening. The blacksmiths had to re-open their shops, and did a brisk business in "turning up," or "roughing" horses. During the evening two children were treated at the Hospital for scalp wounds, caused by slipping on the ice; and later a man was admitted with concussion of the brain, and a woman with a fracture of the fibula from the same cause.

During the night the rain ceased, and it again froze, so that on the morning of the 21st we had an excellent illustration of a glazed frost. It was the more noticeable owing to the previous absence of snow or ice on the roads, and for the suddenness with which the icy coating had developed upon them.

The explanation of this phenomenon is given by Mr. Scott* in these words: "The glazed frost is really the frozen surface which is occasionally produced at the beginning of a thaw if a warm wind suddenly sets in. The damp air, passing over the ground, of which the temperature is exceedingly low, has its moisture deposited in a solid form, and all objects on which this deposit takes place are covered with a sheet of ice."

Instances may commonly be observed on walls where the porous bricks become coated with ice when a long frost is breaking up, but as there is generally more or less snow upon the ground, the phenomenon is not so noticeable as it was upon the present occasion. Sometimes glazed frosts cause a great amount of injury to trees by breaking their branches from the weight of ice deposited upon them.

On the morning of the 21st, the ice-coating on the pebble pavements in some of the streets was found to have become detached during the night from the convex surface of the stones. This was effected by the expansion of the ice as it was deposited, lifting itself from the stone because it was unable to expand laterally, owing to the proximity of the neighbouring pebbles.

* 'Elementary Meteorology.' Robert H. Scott, F.R.S., 4th edition, 1887, p. 115.

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These ice flims were about 5 or 6 m.m. thick, smooth on the concave side where they had been applied to the stone; rough from ice crystals on the convex surface. When held up to the light and viewed from the convex side they were seen to be composed of rounded hexagonal plates, about 8 or 10 m.m. in diameter, reminding one of the diagrams of squamous epithelium, figured in works on anatomy.

On 22nd December a slight fall of snow enabled the possessors of snow sledges to enjoy a few hours sledging the country.

X.

THE MOLLUSCA OF A SUFFOLK PARISH.

By Arthur Mayfield, M.C.S.

Read 28th January, 1902.

The parish of Mendlesham occupies a position near the centre of the county, and covers an area of 3960 acres. The subsoil is mainly a dirty grey clay, with here and there a patch of gravel and brickearth. The surface of the land lies at an elevation of from 180 to 210 feet above the sea level, and may be regarded as the watershed of this part of Suffolk. The southern half of the parish contains sources of the Gipping, and the northern half is drained by the Dove streamlet, a tributary of the Waveney. In summer the beds of these streams, as far as they lie within the parish, may be trodden dryshod from end to end, and every ditch is also quite dried up. In very dry summers like the last (1901) even the ponds, of which there is a large number, the clay making a good basin for them, are reduced to mere muddy pools.

The largest bodies of water are the "moats" in the neighbourhood

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of the farm-houses, surrounding the homestead on two or three sides, and doubtless dug for the purpose of draining the land upon which the buildings stand.

The district is purely agricultural, the whole of the land surface being either arable or pasture. There are no woods; the largest collection of trees is a narrow quadrangular belt of plantation surrounding the Vicarage grounds.

Such are the very adverse circumstances under which the molluscan fauna of Mendlesham holds its existence, affording such strong points of difference from those which obtain in the neighbourhood of Norwich, that an account of the Snails and Slugs of the parish may be of interest to those who, like myself, have searched with scoop, sieve, and collecting box, the environs of the City of Gardens.

The land Snails are chiefly the hedgerow kinds, and, as might be expected, there are few Slugs, even *Agriolimax agrestis* being far from plentiful. The freshwater species are those that can best endure the summer droughts, such as *Limnæa peregra*, *L. truncatula*, *Planorbis spirorbis*, *Bullinus hypnorum* and *Pisidium pusillum*. These species swarm in the larger ditches and ponds, and in early summer may be picked, by dozens, from the surface of the mud.

The populating of these ponds is a matter full of interest. Many of them are entirely unconnected with any other water, and therefore all the species they contain must have migrated thereto by an overland route. To take an instance:—a small isolated pond in the middle of a meadow contains *L. peregra*, *Plan. nautileus*, *Plan. fontanus*, *Velletia lacustris*, *Sph. lacustre*, and *Pis. nitidum*. A careful search in all other water within two or three hundred yards of the spot fails to reveal five of these species, and two of them, viz., *Plan. nautileus* and *V. lacustris*, I have not found elsewhere in the parish. Consequently there is not much chance that such slow travellers as Frogs and Newts have been the means of transport. There are a few bushes at one end of the pond, and at the other the ground slopes down gradually to the edge of the water. It is an ideal spot for birds to alight for a drink or bath, and doubtless the pond owes much of its population to their agency. Horses and cattle, too, are often driven directly from one meadow to another, perhaps a considerable distance although on the same farm. Of course the pond has a great attraction for them, and the

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mud brought on their hoofs must often contain the young of molluscs.

In an upland district such as this, one would not expect to meet with *Unio pictorum*, *Limnæa auricularia*, *Viviparus viviparus*, *Neritina fluviatilis*, and others, that generally frequent rivers and bodies of water of large size, but the absence of the following species is remarkable: *Viviparus contectus*, *Bythinia tentaculata*, *Planorbis carinatus*, *P. corneus*, *Valvata piscinalis*, and *Pisidium amnicum*. At present I have not yet met with *Anodonta cygnaea*, but I have specimens from a pond in an adjoining parish.

The following is a list of the fifty-seven species which occur within the boundary of Mendlesham.

ARION ATER (L). A few, only the black form occurs.

A. HORTENSIS, Fér. In gardens and amongst moss.

A. CIRCUMSCRIPTUS, Johnst. A few in a garden.

AMALIA SOWERBYI (Fér.). One specimen.

LIMAX MAXIMUS, L. In crevices of old stone walls.

L. FLAVUS, L. In cellars and outhouses.

AGRIOLIMAX AGRESTIS, L. Gardens and fields.

A. LÆVIS, Müll. Sparingly near ponds.

VITRINA PELLUCIDA (Müll.). Rather common among wet decaying leaves.

HYALINIA CELLARIA (Müll.). In gardens, under decayed rubbish.

H. GLABRA (Studer). Rather plentiful among dead leaves in hedgerows, and under the bark of old trees.

H. NITIDULA (Drap.). Very common in similar situations to the preceding.

H. PURA (Alder). A few in moss.

H. RADIATULA (Alder). Very sparingly.

H. CRYSTALLINA (Müll.). Very common in all damp places.

H. FULVA (Müll.). Rare; five specimens on a ditch bank,

HELIX ROTUNDATA, Müll. Common; very abundant in the churchyard. I counted over a hundred specimens under the ivy on one tombstone.

H. PYGMÆA, Drap. Common among dead leaves under hedges.

H. ACULEATA, Müll. Not common; a few taken with the preceding species.

H. PULCHELLA, Müll. Sparingly, in the moss on ditch-banks.

H. LAPICIDA, L. Rare; a few specimens in one spot.

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H. ASPERSA, Müll. Not so common as is usual with this species. The vars. *flammea* and *zonata* occur.

H. NEMORALIS, L. Not so plentiful as the next species. The unicolorous forms are vars. *libellula* and *rubella*.

H. HORTENSIS, Müll. The most abundant of the larger Helices, and presenting a great variety of band formation.

„ var. LUTEA. Very common.

„ var. INCARNATA. Rare.

„ var. ARENICOLA. Not uncommon.

„ OLIVACEA. One specimen.

H. RUFESCENS, Penn. Common on hedge-banks.

H. HISPIDA, L. The var. *hispidosa*, Mousson, is the most abundant form; this is generally the case in the Eastern Counties; vars. *depilata*, *nana*, and *albocincta* also occur.

H. ITALA, L. Not uncommon on hedge-banks in company with the two following species.

„ var. MINOR. Common.

„ var. LEUCOZONA. Occasional.

H. CAPERATA, Mont. Only the mottled form occurs.

H. VIRGATA, Da Costa. Not plentiful. The varieties *lineata*, *subalbida*, and *albicans* occur.

BULIMINUS OBSCURUS (Müll.). Appears to be rather plentiful, but is likely to escape notice being generally covered with a coat of clay.

PUPA CYLINDRACEA (Da Costa). Rather rare. I have found it in but one spot.

VERTIGO PYGMÆA (Drap.). Among dead leaves under hedges and amongst moss.

V. EDENTULA (Drap.). Abundant in the churchyard, under ivy on tombstones.

BALEA PERVERSA (L.). Sparingly on the stumps of trees.

CLAUSILIA RUGOSA, Drap. Common in moss on hedge-banks.

C. LAMINATA (Mont.). Plentiful. The Ash, amongst whose dead leaves this species is generally to be found, is abundant in the hedgerows.

COCHLICOPA LUBRICA (Müll.). Not so common as the next following species.

AZECA TRIDENS (Pult.). Very abundant under moss on hedge-and ditch-banks.

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CÆCILIOIDES ACICULA (Müll.). Dead shells in the rejectaments of one of the feeders of the Dove streamlet. Their natural habitat could not be far distant as the shells were found within a quarter of a mile from the source of the stream.

SUCCINEA PUTRIS (L.). Occasionally on the stems and leaves of *Phalaris arundinacea* and *Phragmites communis*, by the sides of ditches.

CARYCHIUM MINIMUM, Müll. Very common among dead leaves in damp places.

PLANORBIS FONTANUS (Lightfoot). Sparingly in ponds and ditches.

P. NAUTILEUS (L.). Plentiful in one pond.

P. ALBUS (L.). On *Lemna minor* and *Callitriche verna* in ditches.

P. SPIRORBIS, Müll. Very common and abundant. This species appears to be especially capable of surviving droughts, being often found, with the aperture of its shell closed by a white epiphragm, in places that are dry for months.

P. UMBILICATUS, Müll. Not common, and of smaller size than usual, approaching var. *rhombea*.

BULLINUS HYPNORUM (L.). Very abundant in nearly every ditch.

LIMNÆA PEREGRA (Müll.). Very common. The specimens found in pools and ditches where the supply of water is very limited, are generally more produced in the spire. Those in the running streams are always small (var. *pulchella*).

L. STAGNALIS (L.). Abundant and of large size in one pond.

L. TRUNCATULA (Müll.). Very common; they may be picked from the surface of the mud at the bottom of ditches, in early summer.

VELLETIA LACUSTRIS (L.). On leaves of *Potamogeton natans* in one pond.

VALVATA CRISTATA, Müll. Abundant in every ditch.

SPHÆRIUM CORNEUM (L.). Common in the mud of moats and ponds.

S. LACUSTRE (Müll.). Not uncommon in ponds.

PISIDIUM FONTINALE (Drap.). Very sparingly and of small size.

P. PUSILLUM (Gmelin). The most abundant of the bivalves.

P. NITIDUM, Jen. Rather common in ditches and pools.

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XI.

A PRELIMINARY LIST OF THE MOSQUITOES OF NORFOLK.

By Sydney H. Long, M.B. Cantab.

Read 25th February, 1902.

As there is not, as far as I am aware, any list extant of the Culicidæ of the county of Norfolk; and as this order of the Diptera has been arousing so much attention during the past two or three years in consequence of the close relationship that is now known to exist between many of the blood-sucking insects and the transference of certain diseases of man and animals—notably Malaria and Yellow Fever—I have commenced to make a collection of the Mosquitoes of the county. Since, however, my observations have hitherto not been very extended, and have been spread over a period of about eighteen months only, it is scarcely necessary to say that the following list is by no means a complete one, though, as time goes on, I hope to be able to make additions to it.

Abbreviations:—*i* Imago; *l* Larvæ.

Genus Anopheles.

Anopheles maculipennis. Meigen.

Castleacre, *i,l;* Brundall, *i,l;* Burlingham, *i,l;* Harleston, *i,l;* Horsey, *i,l;* South Walsham, *i,l;* Twyford, *i,l.*

Anopheles bifurcatus. Linnaeus.

Burlingham, *i,l;* Horsey, *i,l;* Potter Heigham, *i,l;* Wroxham, *i.*

Genus Culex.

Culex pipiens. Linnaeus.

Alby; Burlingham; Caister-on-Sea; Castle-acre; Horsey; Norwich; Potter Heigham; Twyford; Wroxham.

Taeniorhynchus richardii. Ficalbi.

Brundall; Burlingham; Horsey; Neatishead; Norwich; Wroxham.

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CULEX ANNULATUS. Schrank.
Burlingham; Norwich; Wroxham.
CULEX NEMOROSUS. Meigen.
Burlingham.
CULEX MORSITANS. Theobald.
Burlingham; Wroxham. Only once before recorded in England.
CULEX NIGRITULUS. Zetterstedt.
Potter Heigham.

NOTE.—In the case of the Genus *Culex* the record in all cases applies to the finding of the Gnats themselves. At present I am unable to identify many of the larvæ of this genus.

XII.

NOTES ON THE HERRING FISHERY OF 1901.

BY T. J. WIGG,

Honorary Secretary Great Yarmouth Section.

Read 25th February, 1902.

IN my Notes on the Herring Fishery of 1900, I mentioned the fact that the number of fish caught and brought into Yarmouth Harbour had never been exceeded. Such indeed was the fact; but this year I have again to chronicle not only an increased catch (Yarmouth 633 lasts, and Lowestoft 1509 lasts more than last year), but also a greater number of boats engaged, and many more persons employed in the various departments of the industry.

The spring fishing of 1901 was rather unproductive, and but few good fish were caught until June and July, when the so-called midsummer fishing was in full swing. From the end of July to the middle of September the catches were of an average character. With the beginning of October, business commenced in earnest, and the Fish Wharf and that portion of the South Denes contiguous to it assumed a busy aspect.

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In preparation for the fishing, the Corporation had extended the Quay to the south of the Fish Wharf, and this portion was set apart for the exclusive use of the great army of Scotchmen who frequent this port.

Very little fishing could be done during the first half of October on account of the boisterous weather, and those vessels whose crews were brave (or ill-advised) enough to venture out to sea, were glad to return, showing signs of the buffeting they had experienced. However, "It's an ill wind that blows nobody good," and the rough weather had the effect of bringing together the shoals of fish, so that they were more in touch with the fishers. The scene at the Fish Wharf soon became an animated one, and the Wharf Master and his assistants were most active in providing berths for incoming vessels, and doing all in their power to prevent utter confusion. The salesmen, too, were hard at it, and had but little leisure time. The clanging of bells and shouting of "runners," mingling with the clattering of carts removing the Herrings to the gutting grounds and houses, made up a scene that must be seen to be fully realised.

The 'Yarmouth and Gorleston Times' of November 2nd, 1901, thus describes a scene at the Fish Wharf:—"It was a sight to see the Fish Wharf on Sunday, October 20th, but remembrance of that scene faded away before that which met the eye on Sunday the 27th. The English boats, which had been out on Saturday, began to return into port early on Sunday morning, and as they had, all of them, big cargoes, it was patent to all that the boats must have struck great shoals that are now working their way up from the North. The Fish Wharf was speedily lined with steamers, loaded with eighteen to twenty-two lasts of Herrings per boat, and the work of landing began without loss of time. A boat discharged, and there were others ready to take her place, and soon the Wharf right up to the ferry was thickly covered with hundreds of thousands of Herrings, which glittered and sparkled in the rays of the autumnal sunshine. Counting was out of the question, as the boats were all eager to get out again after more, so the Herrings were put into huge heaps, encircled by swills, and plentifully sprinkled with salt. The Wharf being full up, the covered-in market was quickly filled up also with heaps of "shiners;" but the cry was "still they come." Carting is not done on Sundays to

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any great extent, and as the boats came in they had to discharge at the new Quay, and all the way along here was soon covered with Herrings. During the day crowds of residents flocked to the Wharf to witness the remarkable scene, which beat all previous records. Four ferry boats had all they could do all day to cope with the traffic across the river, and the wonder is amid so much bustle and confusion that no mishaps occurred to the heavily-loaded boats. In striking contrast to the clanging and shouting, services were being held for the Scotties, but the attendance was small in consequence of the animated scenes going on all along the Wharf."

During the first week in November the fishing was again stopped for several days, owing to the prevalence of very stormy weather, and the scene in the Harbour was a most remarkable one—vessels were lying three and four deep from the Fish Wharf quite up to the Southtown Bridge, so that the Wharf Master and other officials were almost at their wits' end to know where to berth the craft. At one time there was such a crush of boats in the river that an intrepid (if somewhat rash) gentleman decided to cross from one side of the river to the other by means of the fishing-boats, and succeeded in doing so.*

A spell of fine weather was very welcome to the fishers, especially to those from the Scotch ports, and some very good catches were made during the latter days of November, but evidently the Scotchmen had grown tired of enforced inactivity day after day, and the majority of them decided to "make up" and leave for home. The crews who remained had no cause for regret, for during

* "The congested state of the Harbour, which was discussed at the Town Council's meeting on Tuesday, was, perhaps, never more noticeable than it was during Tuesday night and Wednesday morning. From the Haven Bridge to some distance up the river the boats were lying very thick, and only a very narrow channel remained mid-stream. Within a short distance of the Town Hall there was an unusually large number of the fishing fleet of Scotch and Yarmouth boats laid up owing to the gale, and opposite Messrs. Clarke's milling premises, Mr. Arthur Patterson, an attendance-officer of the Yarmouth School Board, and a well-known ornithologist, walked across the river on the fishing-boats. He was able to accomplish this somewhat easily, but was compelled to make a jump of about three feet in the middle of the stream. A similar feat has been accomplished on previous occasions at the Fish Wharf, prior to the remunerative improvements recently effected by the Corporation, but never before has it been possible so high up the river as the Town Hall." ('Yarmouth and Gorleston Times.')

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the early part of December many good catches were made, and good prices obtained, although the earnings of the Scottish fishing fleet at Yarmouth have been exceedingly varied. The boat which earned most was the Banff craft "Racer," which has made the sum of £500. The "Queen" from Fraserburgh earned £410, while two other boats from the same port made £252 and £180 respectively. These however are exceptions, and the average would probably work out at about £120 per boat.

It is satisfactory to note that the fishing has been very successful. The quantity of Herrings landed has beaten the huge total of last year, and, but for the bad weather experienced in November, the catch would have been much more in excess. The quality, too, has been very good indeed. More buyers than ever have been here this season, more boats have fished out of the port, and the influx of thousands of extra hands into the town must have benefited the residents and tradespeople generally. The improvements effected last year have been much appreciated by the visitors, and leading traders are agreed that Yarmouth, as a central depôt for the great Herring trade, is second to no other port along the coast.

The Scotch fishermen appear to regard Yarmouth with greater favour year by year. This year no less than 446 Scotch boats fished from the harbour, comprising 141 from Banff, Aberdeen 8, Leith 38, Berwick 33, Inverness 50, Kirkcaldy 74, Wick 18, Fraserburgh 42, Peterhead 16, Arbroath 2, Montrose 22, Stornaway 1, Newhaven 1. In addition to these, there was one Irish boat from Tralee, while North Shields sent 13, Sunderland 5, Grimsby 2, Hull 6, and Southampton 1, making a total of 474 boats, in addition to the 155 Yarmouth vessels. Among these boats there were 54 steam drifters belonging to Yarmouth, while 67 were chartered from other ports.

The export and import business has been most successful this season. A large number of steamers brought in stock and empties (barrels), and took away large cargoes of Herrings to various ports in Sweden, Norway, Russia, and Holland.

About 2000 Scotchwomen and girls arrived in Yarmouth for the Herring season towards the end of October. With the beginning of May they start on their pilgrimage in the extreme North of

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Scotland. They accompany their boats and the fishermen, and in fair weather, when the boats can face the sea, they work from fourteen to sixteen hours a day. Stormy weather means slackness of work for them. June usually terminates the northern season, and there is a general move from Stornaway to Fraserburgh, Aberdeen, and Peterhead, thence to Scarborough, Grimsby, Yarmouth, and Lowestoft; and then home to their knitting, their mending of nets, and the winter life of the fisher-girl.

RETURN OF HERRINGS LANDED AT YARMOUTH IN 1901.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	319
February	—	July	623
March	1	August	923
April	41	September	1,721
May	93	October	14,787
June	184	November	9,535
		December	1,725
Carried forward	319	Total	29,633

Number of Yarmouth boats . . . 155
„ Scotch and other boats . 474

RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1901.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	1,471
February	—	July	1096
March	72	August	46
April	574	September	101
May	541	October	9,145
June	284	November	7,917
		December	1,996
Carried forward	1,471	Total	21,772

Number of Lowestoft boats . . . 222
„ Scotch „ . . . 305
„ West Country boats . . 6

ADDITIONAL NOTES BY MR. A. PATTERSON.

THE Herring Fishery of 1901 has been, from a Naturalist's standpoint, an uninteresting one; its one feature has been—the Herring and the Herring solely. An entire absence of rapacious fishes, and an almost equal scarcity of Cetaceans have characterised it, only

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three Porpoises (*Phocæna communis*) to my knowledge having been brought to the Fish Wharf, early in the season. Sharks have been altogether absent, and remarkably few Piked Dogfishes (*Acanthias vulgaris*) have been netted. In the case of the larger enemies of *Clupea harengus*, I am half inclined to think the great number of Steam Drifters employed this year has had the effect of frightening them away from the shoals by their noisy bustling methods of work. Herrings have been numerous enough in all conscience, but singularly free from other interloping pelagic fishes, *e.g.*, Cods, Mackerel, Whitings, and the like, to account for the disappearance of which it is difficult to hazard an opinion. I only know of two or three large Codfishes being brought in by Scotch fishermen, who in some years have caught hundreds of superb fish by means of long lines thrown out while the nets have been drifting. In some years, too, Whitings have been exceedingly abundant, mixed in with the Herring shoals; the fisher-folk do not want them, and I have heard an opinion expressed that "a *maund* of Whitings to ten last of fish is not a very troublesome addition;" and again, "the more Mackerel caught the less Herrings taken,"—a fairly obvious truism, when we recollect that Mackerel rise in breezy weather, and Herrings do not. On the other hand, the shoals of Whiting inshored in unusual numbers, to the great delight of many local sea-anglers.

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XIII.

ON AN UNPUBLISHED LETTER FROM DR. THOMAS BROWNE TO MR. WILLIAM DUGDALE.

By Thomas Southwell, F.Z.S., V.-P.

Read 25th February, 1902.

The following letter, for a copy of which I am indebted to the kindness of Mr. Ellis H. Minns, the Librarian of Pembroke College, Cambridge, and which, although it has been referred to more than once,* has not, so far as I know, been published *in extenso*, is preserved in the Library of Pembroke, where it is numbered 104, in a bound volume of MSS. It is endorsed in an Eighteenth Century handwriting, which Mr. Minns suggests may be that of Thomas Browne, who was Master of Pembroke College from 1693 to 1706: "Letter of Sr Tho Browne of Norwich, an eminent Physitian & virtuoso" and is directed to "Mr. Wm. Dugdale at his Lodging at ye Seven Stars on ye North side of St Pauls Ch. Yard London" ["This was wrote in, or about 1660" added].

But first, to make the subject of the letter intelligible, I must mention that in October and November, 1658, Dugdale had been corresponding with Browne, relative to the bone of a "fish which was taken up by Sir Robert Catton in digging a pond at the skirt of Connington downe," and which bone he had sent to Browne asking him his opinion thereof.† After stating that he would first compare the bone with some other which was not then by him, Browne in a subsequent letter‡ states that it is a vertebra of "some large fish and not of any terrestreous animal," at the same time enumerating other instances of similar occurrences in apparently impossible situations, and giving his reasons for "not being ready

* See Hist. MS. Commission, Pembroke Coll. Camb. vol. v. p. 487. Also 'Excursions through the County of Norfolk' (1818), vol. i. p. 121.

† 'Life, Diary, and Correspondence of Sir William Dugdale,' Edited by Wm. Hamper. London MDCCCXXVII. pp. 337, 339, and 343.

‡ 'Notes and Letters of Sir Thomas Browne on the Natural History of Norfolk.' T. Southwell, 1902, appendix p. 91.

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to believe that wherever such relics of fish or sea animals are found, the sea hath had its course," but, as will be seen, he accepts the Connington find as "authentically testified by all circumstances." The letter is as follows:—

"Worthy Sr

I received your letter and now send you a short paper concerning some Queries in your former In the last I sent you I did not make any doubt of the truth of the fishbones. butt cast in some doubts more proper to some other things of the like nature then this, wch is soe authentically testified by all circumstances. & case only its doubt in the place where it was first lodged if [found *added above*] lowe, or drawne ashore if on the toppe of the downe. as [4 *crossed out*] yeares agoe the head [& bones *in the margin*] of a very great fish [was *crossed out*] yet to be seen was found at Hasburge in Norfolk when the cliffe fell downe, as it is eaten away by the sea, & this was within a yard of the toppe. Pray at your opportunity my service to Mr. Ashmole I wish I were able to doe you any [services *crossed out*] substantiall service or testifie my respects unto you in any proportion to my desires or inclination towards a person of soe much worth & Ingenuitie as yourself. Sr I am very affectionate friend & Servant

THO BROWNE"

"Sr I vnderstand a second volume of Monasticon Anglicanũ is in the Presse & almost finished. I should bee glad to vnderstand, whether it will bee a distinct piece or the first also taken into it.

Your letters will come more safely vnto mee if you leave the [caryadg *crossed out*] post unpayd.

Norwich Nov XVII [1659?]

The expression "I now send you a short paper" &c., can hardly apply to the brief reference to the fossil bones from Happisburgh cliffs contained in this letter, and conveys the impression that a more detailed account of the occurrence was enclosed; if so, it is unfortunate that it is not forthcoming, for the chief interest in the letter lies in the statement that the "head & bones of a very *great fish*" had been embedded in the cliffs *near to the top*, which facts are incompatible with their having been derived from the Forest-bed, but I shall revert to this later on.

My friend, Mr. Clement Reid, has been so good as to search the records of the Royal Society, but can find no reference to these Happisburgh bones; he, however, sends me the following interesting extract from 'Hooke's Posthumous Works' (p. 313), consisting of a letter from Dr. Browne, written some years later, in which he gives an account of the finding of certain bones, apparently Mammalian remains from the Forest-bed. This is worth quoting,

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although it does not throw any light upon the supposed "fish" bones.

Hooke writes: "the Royal Society received a memorable Account from the Learned *Dr Brown* concerning a Petrified Bone of a prodigious bigness discover'd by the falling of some cliffs; the words of the Relation are these. 'This Bone' (which he presented to the Royal Society, and is now in the Repository) was found last year 1666. on the Sea Shore, not far from *Winterton* in *Norfolk;* it was found near the Clift after two great Floods, some thousand Loads of Earth being broken down by the rage of the Sea, as it often happens upon this Coast, where the Cliffs consist not of Rock but of Earth. That it came not out of the Sea may be conjectur'd because it was found near the Cliff, & by the color of it, for if out of the Sea it would have been whiter. Upon the same Coast, but as I take it, nearer Hasborough, divers great Bones are said to have been found, & I have seen a lower Jaw containing Teeth of a prodigious bigness & somewhat petrified. All that have been found on this Coast have been found after the falling of some Cliff, where the outward Crust is fallen off, it clearly resembles the Bones of Whales & great Cetaceous Animals, comparing it with the Skull & Bones of a Whale which was cast upon the Coast near *Wells*, & which I have by me, the weight whereof is 55 Pounds.'"

Mr. Reid can find no reference to this letter in the Phil. Trans. but suggests that as Hooke held some official position in the Royal Society in 1667, the communication may have been addressed to him personally; nor does he find any reference to the specimen in Birch's History of the Royal Society, nor in Grews 'Catalogue.'

The Whale mentioned by way of comparison in this letter is doubtless one referred to by Browne in a letter to Dugdale (see Notes on the Nat. Hist. of Norf. p. 92), which he says was 62 feet in length, and came ashore at Wells about the year 1652.

So long ago as the year 1746, our fellow citizen William Arderon contributed a paper to the Royal Society (Phil. Trans. vol. xliv. pt. I, No. 481, p. 275), in which he described the "dreadful heights" on the north-east sea coast of Norfolk, which were constantly falling, only to be washed away by the billows, and mentions the "roots & trunks of trees which are to be seen at low water in several places near Hasborough and Walket" where "bones of animals are often to be found;" and the compiler of the 'Excursions through the

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County of Norfolk' (vol i. p. 121) in 1818, makes direct reference to the letter of Browne to Dugdale given above, which he says is dated Nov 17, 1659, but he does not tell us by what means he had access to the document. Richard Taylor, also, in a communication to the 'Philosophical Magazine' (p. 135), dated Norwich, 14th August, 1822, mentions the same letter, probably quoting from the "Excursions," and repeating the discovery of the head and bones of a very large "fish" by the falling of the cliff, but they do not appreciate the significance of the different horizon in which the so-called "fish-bones" are said to have been found; for although there can be no doubt that the mammalian remains found at the base of the cliffs had their origin in the Forest-bed, the "lower jaw containing teeth of prodigious bigness" being most likely that of some species of *Elephas*, any vertebrate remains from the upper stratum of the cliff must have had a very different origin. The fact too of the skull being associated with other bones, presumably of the same animal, would alone render it highly improbable that they were derived from the Forest-bed.

Mr. Clement Reid, in his Survey Memoir of "The Geology of the Country around Cromer" (p. 20), refers to Taylor's mention of the bones of the "very large fish;" and appreciating the difficulty with regard to their occurrence in such a situation, suggests the probability of some mistake. But in the face of Browne's positive assertion, and considering his well-known accuracy of observation, it seems impossible that he was altogether mistaken as to their position in the cliff, or as to their fish-like character. We must therefore, it seems to me, look to some other source of origin; and the only feasible solution of the puzzle is, I think, one now suggested by Mr. Reid, which, however, he does not advance with any degree of confidence, namely, that the bones may have been those of some fish-like Saurian derived from a transported mass of Kimeridge, or Lias shale embedded in the boulder clay with which the cliffs in that locality are capped, and which seen by Browne may have been mistaken for the bones of some "great fish" or Cetacean, which terms were synonymous in those days; or it is even within the realm of possibility, seeing the rapid waste of the coast which has taken place in that locality, that Browne may have seen some deposit which has since been destroyed by the wearing away of the cliff.

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XIV.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1901.

By Frank Leney,

Assistant-Curator of Norwich Museum.

Read 25th February, 1902.

Although during the year 1901 the additions to the Natural History collections were numerous, and in some cases valuable, there are not many calling for special mention. The following list will, however, show that the interest of collectors in our beautiful Museum has been well maintained.

No additions have been made to the Mammalia, but the collection of Reptiles has been enriched by Mr. W. J. O. Holmes, who presented a fine specimen of a Mississippi Alligator (*Alligator mississipiensis*), obtained off the coast of Florida.

Mr. J. H. Gurney has kindly supplied the following notes on the Birds of Prey added to the collection:—"An adult example of the Buzzard of the Galapagos Islands, collected on Abingdon, one of the islands of that group, by Mr. C. M. Harris, and marked by him:—*Buteo galapagensis* (Gould), August 13th, 1897, ♀ eyes straw-yellow, legs and feet light yellow—is a fine contrast to the immature skin obtained by the Museum in 1894, in which the prevailing tone is rufous. Probably it passes through the same changes as its smaller northern ally, *B. swainsoni*, from which it is, however, very distinct. This is the only Diurnal Raptorial calling for remark, but a few slight alterations have been made in the Owl Gallery, where there are still gaps to be filled.

"Of the various races of the Short-eared Owl there can be little doubt that one at least, *Brachyotus* (*Asio*) *galapagensis*, Gould, is worthy of separation for its very dark colouration, and accordingly, an adult male collected on Hood Island, one of the Galapagos group,

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by Mr. Harris, on October 22nd, 1897, is an acceptable addition to our long series of these birds. Messrs. Rothschild and Hartert consider *B. galapagensis* to be the only known near ally of *B. accipitrinus*, into which they would merge the various other described races (Nov. Zool. vol. vi. p. 175). It seems to be found on all the islands of the Galapagos group.

"Another addition is *Ninox* (*Hieraglaux*) *granti*, Sharpe, described in P. Z. S., 1888, p. 183. The present example was collected by Mr. A. S. Meek, one of Mr. Rothschild's successful collectors, on Guadalcanar, one of the islands of the Solomon Archipelago, on the 9th of May, 1901, and is ticketed 'Female, iris brownish-yellow, feet straw-yellow, bill greenish.' Its nearest ally is considered by Dr. Sharpe to be *N. punctulata*, of which the Norwich Museum has three specimens. Mr. Meek appears to have sent home a series of *N. granti* to the Tring Museum (See Nov. Zool. vol. viii. p. 381), which is so rich in novelties of all kinds."

Mr. Gurney also presented several specimens of rare British birds obtained in Norfolk, viz., Lesser Grey Shrike (*Lanius minor*), caught alive in a greenhouse at Yarmouth in 1875. The following memorandum is on the label: "Sent by A. Harvey, from whom I bought it, to Roberts, birdstuffer, Norwich, who received it on May 31st, showed it in the flesh to Mr. Henry Stevenson, then mounted it. J.H.G." See Manual B.B., p. 149. Ortolan Bunting (*Emberiza hortulana*), killed at Yarmouth in 1866. "Mr. Barnes, who shot the Richard's Pipit, corroborates Harvey's statement that this Ortolan was netted at Yarmouth in April, 1866, and kept alive by him two days." Whiskered Tern (*Hydrochelidon hybrida*), shot on Hickling Broad in 1847. "An old female, and is noticed in vol. v. of the 'Zoologist.'" Ruddy Sheldrake (*Tadorna casarca*), found dead on Snettisham beach on September 13th, 1892.

Colonel Feilden presented two beautiful specimens of the Ivory Gull (*Pagophila eburnea*), one from the Faroë Islands, killed December, 1892, and the other from Brevort Island, Smith's Sound, killed July 31st, 1875.

Mr. Thomas Baring, of Hockham Hall, has added some valuable, and also new species of birds to the foreign collection. Amongst those worthy of special notice are the nestlings of Little Shearwater (*Puffinus assimilis*), the White-breasted Petrel (*Pelagodroma marina*), and Bulwer's Petrel (*Bulweria bulweri*), all obtained by

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the Hon. Charles Baring and Mr. Ogilvie Grant of the British Museum, during a visit to the Salvage Islands (see W. R. Ogilvie Grant on Birds observed at the Salvage Islands, 'Ibis,' 1896, pp. 50, 51, and 54). An interesting account of these Islands will also be found in the 'Field' for September 25th, 1895. Mr. Baring also gave examples of two species of Tinamou (*Calopegus elegans* and *Nothura darwini*), neither of which were hitherto represented in the Museum. These "South American Partridges," as they are called, were shot on the plains above Cordova, and although formerly abundant, they are fast disappearing before the all-destroying Italian immigrants. Several other rare birds from New York and the Arctic regions were also included in this donation.

An interesting addition to the Oological collection is a series of fifty-two varieties of the egg of the Guillemot (*Uria troile*) from Scarborough, presented by Mr. J. H. Walter, and several nests and eggs from Borneo, presented by Mr. James Reeve.

The principal additions to other departments of Natural History are, a large "Bath Sponge" (*Euspongia zimocca*) from Punta Gorda, South Coast of Florida, presented by Mr. W. J. O. Holmes; and two large univalve Shells, *Triton variegatum* from the Red Sea and *Fusus proboscidiferus* from Singapore, presented by Mr. Howard H. Room.

Many other valuable gifts were received during the past year, but although interesting, they do not fall within the scope of this brief notice.

NOTE.—This paper is a continuation of the series which Mr. Thomas Southwell has contributed to the Transactions of this Society during the years 1888 to 1900.

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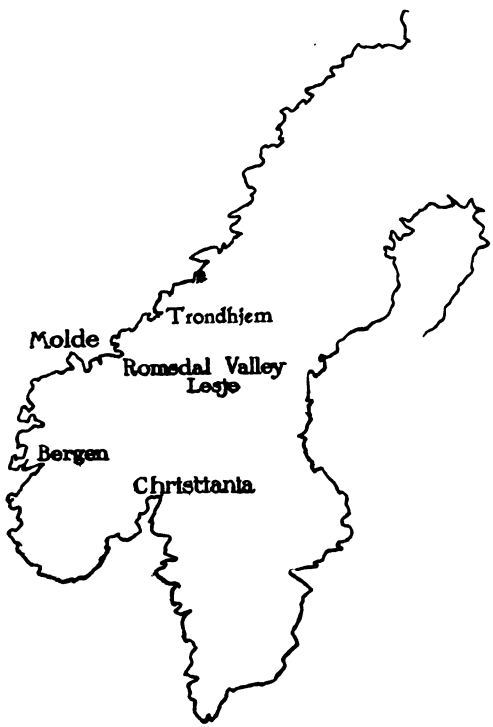
XV.

ORNITHOLOGICAL NOTES FROM SOUTHERN NORWAY.

By J. H. Gurney, F.L.S., V.-P.

Read 25th February, 1902.

The following memoranda were almost entirely taken in a three weeks' fishing visit, lasting from August 17th to September 3rd, 1901, to a friend in the Romsdal, one of the finest valleys in Southern Norway; the position which it occupies is marked on the annexed map. Many accounts have at different times been



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published of Norwegian birds, and amongst the rest in 'The Zoologist,' by Messrs. Slater, Aplin, and Salter, but I am surprised to see that neither of these writers mention the Siberian Jay (*Garrulus infaustus*), one of the most noticeable birds in Norway, and far less of a migrant than our handsome *G. glandarius*, not so handsome, perhaps, but more confiding.

There were at least two or three pairs at Lesje Vœrk, and I heard on good authority of a flock of as many as eight. By all accounts they have a good deal of curiosity in their nature, which will perhaps lead them to come and watch a man fishing, or look at a hunter having his lunch; and it is said that in the north a flock can be all shot down one after the other. The dorsal plumage is very thick, and must be a great protection against the cold in winter. In the Norwich Museum are two nests of *G. infaustus*, collected by Wolley, possibly the same described by Professor Newton in Dresser's 'Birds of Europe.' They differ considerably in their fabric: one is a flat nest of dense fibres, rootlets of Moss with Lichen (*Usnea barbata?*); while the other contains a great number of feathers, among which are those of the Capercaillie, Willow Grouse, and Heron.

In such a country I naturally expected to find Woodpeckers abundant, and from Professor Collett I learnt that the Great Black Woodpecker (*Picus martius*) was to be met with at times in our valley—another bird which has probably never crossed the North Sea to England, in spite of many statements to the contrary. Mr. F. S. Mitchell found a nest at Stuen, a station in the next valley, hewn in a Pine to the depth of twenty-two inches (Zool. 1877, p. 201). Another nest in the Christiania Museum, shown by Professor Collett, was also in the bole of a Pine; a tree no doubt very much to their liking, and of which certainly there are no lack. The immense stretches of fir woods in Norway are very impressive to one who sees them for the first time, and they must be a congenial home for the Woodpeckers, which have enormous Ant heaps filled with Ants ready at hand—some of them a yard high—and it is said Woodpeckers are more productive than they are in England.

P. viridis not unfrequently lays as many as eight eggs in Norway, even hatching that number out (Collett). We did not come across *P. tridactylus*, but H. saw a black-and-white Woodpecker clinging

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to a telephone post, which was most likely *P. major*. The Grey-headed Woodpecker, *P. canus*, is, if I am not mistaken, common. At first I thought they were only our Green Woodpecker, they struck me at the time as being very small, but I was deceived by the "laugh," and yet even in that there is a difference.

Falco tinnunculus, *F. œsalon*, and *Accipiter nisus*, are the Hawks of the Romsdal. Near Molde were two fine Falcons, one of them chased by a cloud of Terns, the other gyrating and toying in the air with some Lesser Black-backed Gulls, which I thought were Peregrines; but Professor Collett tells me they are more likely to have been Gyr Falcons (*F. gyrfalco*), which are very Peregrine-like in colour, but generally larger. One of these fine birds, however, showed the moustache so plainly, that I am convinced it was a Peregrine Falcon.

That grand bird, the Eagle Owl (*Bubo ignavus*), is probably not uncommon in the Romsdal. One was seen by my companions on August 16th, in broad daylight, on a tree, and again a day or two afterwards, flapping across the lake where it is narrow, perhaps in quest of fish. It is a very sedentary bird, perhaps none in Europe more so, and it is exceedingly doubtful if it has ever crossed the North Sea. An Owl, seen by H. on September 4th, was most likely *Asio otus*. In 1895 the Eagle Owl bred in the valley, and H. brought a young one to England which I believe is still alive.

In February, 1895, a Reindeer hunter named Huns shot an adult Snowy Owl (*Nyctea scandiaca*), which he sent to H. in the flesh by post. It measured 58½ inches in the spread of its wings, and weighed 4 lbs. 2 ozs., and its small ears and long-pointed oil-gland were particularly noticeable. In the summer of the same year he found three young ones on the ground recently hatched: this I believe was a Lemming year, when these pretty little quadrupeds were abundant. The nest was about half way up a mountain called Storhoi, at an elevation of about 4500 feet, and it was only after several days watching the old birds that Huns found it. H. brought the young ones to England, except one which died on the voyage; it was September when the other two arrived, and it was at once noticed that one was whiter than the other and rather larger, but this which was certainly a male was ultimately the smaller of the two. These birds could not use their wings until the middle of November, and when they did fly they always preferred the

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ground to stumps of trees placed in their cage. They are not nearly so hardy as *Bubo ignavus*, and mind the cold more. I made the following notes on these Snowy Owls in confinement. When they want to drink they have a power of putting back the facial bristles from the beak in such a way as to partly conceal the eyes. The tongue is large and the mouth pink, and they can turn their heads round quite independently of their bodies, so as it were to face backwards, and do it without in any way ruffling the feathers of the neck. On a warm day in August, the hen was to be seen raising her wings, at the same time lowering the head and moving it from side to side with a low crooning note, indicative of pleasure and a desire to breed. The plumage of the head seems to be the last part to moult. The cock would sometimes hoot in the day-time.

The Capercaillie, termed in Norwegian a "Tiur," is found in the valley and down to the margin of Lesje lake, and is fairly common according to Micha, the station-master. H. saw three fly across the lake; and I stumbled on a cock as he was feeding in a marshy place by its edge, where there were a great many Birch, a tree the "Tiur" is rather partial to. H. has also seen others, and they are not rare, though not easy to shoot. There is an old story about the Capercaillie that after death it swallows its tongue, which seems to be truer than it sounds; for that organ is generally retracted so far by the hyoid bones, as to become nearly invisible when sought for.* The Norwegian Bishop, Pontoppidan, says Capercaillies bury themselves in the snow in winter, and that the Foxes find this out and kill them.

The Black Grouse (Aarfugl. *Male*, Aarhane. *Female*, Aarhone) likes moist places, and can be sought for among the Birch trees, and especially where it is marshy. The Willow Grouse (*Lagopus albus*, Skovripa) is not to be met with here: they will be found higher up the mountain where trees cease and the "fjeld" begins, but are not so common as they used to be, and neither this species nor the Black Grouse are easy to flush without a dog. H. put up ten Black Grouse on August 17th, and about seven more on September 4th. In Christiania Museum there is a Blackcock assuming Greyhen's plumage, which is much rarer than the converse, of which also there are examples.

* *Cf.* Beckmann, 'Field,' December 31st, 1864.

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The name "Fjeld-ripa" is a little confusing to a stranger, for it is sometimes applied to the Willow Grouse, and sometimes to the Ptarmigan (*Lagopus mutus*), which are only met with in the company of Snow Buntings, at a height of 6000 feet. I neither saw nor heard anything of the Hazel Grouse (*Bonasa betulina*), which is comparatively rare; it is probably from much further east that the London supply of this delicacy comes.

Scaup and Golden Eye are shot sometimes, but the Mallard is less numerous than it used to be. H. used to get a good many Teal, but I only saw two. Herring Gulls come up the valley occasionally, and we pursued one fine old Cormorant with no more dangerous weapons than our fishing-rods. On September 5th H. saw some Red-breasted Mergansers at the mouth of the valley, and on the 6th, a flock of seventeen at Naes. They must breed, as some years ago he sent to England a nestling about one-third grown.

The only other specially interesting birds to be mentioned were the Black-throated Divers on the lake; the young already as large and quite as strong on the wing as their parents. They also breed here. The Red-throated Diver has been shot once, if not oftener, but not last year, and it is not impossible that *Colymbus adamsi* may be some day met with. When Mr. Eustace Gurney was at this place, he met with Cranes, but no such good luck happened to our party.

There is one thing which must strike any one who goes to Norway—the absence of birds in the forests, but to an Englishman it seems a paucity of individuals rather than of species; and the same lack of bird-life is noticeable in many other parts of Europe, where there are large tracts of forest land uninhabited by man, which offer but little food to bird-life. The same thing may be seen on a smaller scale in our own New Forest and among the timber-clad hills of The Var in France. In 1891, Professor Collett only put the number of species of Norwegian birds at 278, a low figure compared with the British avifauna, considered by Mr. Howard Saunders to stand at 384.

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XVI.

METEOROLOGICAL NOTES, 1901.

(From observations taken at Bradestone House, Brundall, Norfolk.)

By Arthur W. Preston, F. R. Met. Soc.

Read 25th February, 1902.

January.

This was an exceedingly dry month, the total rainfall being but three quarters of an inch, of which 0.28 in. was melted snow. There were some cold days in the second week, the maxima being exceptionally low. There were no very severe frosts, although on the night of the 9th the exposed thermometer fell to 9 degrees, which was 13 degrees lower than the minimum recorded by the screened instrument. The third week was mild, but the month closed with some winterly weather and snowstorms. The most remarkable phenomenon of the month was a severe thunderstorm on the afternoon of the 28th, accompanied by great darkness. At 3.40 p.m. the blackness of night seemed to sweep down with extraordinary suddenness. For twenty minutes a thunderstorm of unusual violence prevailed, the lightning being exceedingly brilliant, and affording a weird contrast to the existing gloom. The proximity of the storm was exemplified by the startling suddenness with which the reports followed each flash. Snow and hail accompanied the storm, which passed away to the south-eastward soon after 4 p.m. Electrical storms of this character, though rare, are by no means unknown in winter. As recently as the 23rd January, 1895, a very similar storm burst over London. On the 6th January, 1872, a severe thunderstorm occurred in Suffolk, and many other counties, when there was much damage by lightning. Similar storms are stated to have visited Eastern England on the 16th January, 1871, 13th December, 1866, 17th December, 1852, and 3rd January 1841.

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February.

The winterly weather which set in during the last week of January continued until the closing days of February, during which time there were sharp frosts and frequent snowfalls, and on the 12th the snow was nearly a foot deep on the level. The mean temperature of the month (34.9 degrees) was about five degrees below the average, and the month presented more winterly traits than any February since 1895, which was one of the most rigorous on record.

March.

This month was an unkindly one throughout, and although March is proverbially a month of "many weathers," seldom has a more generally unpleasant one been experienced than that of 1901. The second half of the month was decidedly colder and more ungenial than the first half, but an exceptional amount of cloud prevailed throughout, and there were but three days which could be called bright. Thunder occurred on the 1st, and a thunderstorm, accompanied by snow, on the afternoon of the 28th. Gales were experienced on the 5th and 6th from the South-west, veering to North-west, but the worst winds of the month were on the 19th, 20th, and 21st, accompanied by snow and rain, and were the roughest and most penetrating which had been experienced for a long time past. Snow fell on six days, and on the 27th was from three to four inches deep on the level.

April.

April gave us two distinct types of weather, bad and good, the bad extending from the 1st to the 16th, with rain almost daily, and frequent thunder; the last half of the month was dry, and partly very warm, accompanied by a most unusual amount of bright sunshine, reminding us of the brilliant April days of 1893. Vegetation was very backward down to the middle of the month, and later than for many years past. The sunshine of the last fortnight forced on vegetation with remarkable rapidity, and much progress was made in growth generally. At the close of the month the fruit trees were getting well into bloom, and the country wore a spring-like look of great beauty.

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May.

With the exception of some rather heavy local showers on the 6th, 7th, and 29th, the month may be said to have been almost rainless. No rain whatever was registered between the 9th and 25th. The mean temperature, owing to warm weather in the last week, came up to the average standard for May for the first time for six years past. But down to the 24th day it was decidedly cold, owing to the penetrating character and persistency of prevalent easterly winds. The hygrometrical readings were abnormally low; on many days, at 9 a.m., the percentage of relative humidity was under 65 per cent., and on the 23rd was as low as 57 per cent. This, combined with the absence of rain, and the dryness of the easterly wind, parched the soil to an unusual extent.

June.

This was a fine and exceedingly pleasant summer month, with no great excess of heat. There were many bright days, interspersed with acceptable rains during the third week and the last night; but the early part of the month was very dry, and following on the parching weather of May the drought was much felt. There was but little thunder, and the percentage of humidity was lower than for some years past.

July.

This was the third exceptionally warm July in succession, and as a whole, the month may be said to have been as fine a period of summer weather as could be desired. Though 1.4 degrees cooler than the previous July, it was nevertheless quite 3 degrees above the average, and the thermometer exceeded 80 degrees on six days. The nights were cooler than last year, and after the overpowering heat by day, the reduction of temperature in the evenings was particularly acceptable. Absolute drought prevailed from the 5th to the 24th, a period of nineteen days. In the fourth week there were rains of a partial character. In places the downpours were torrential, and in others, near by, not a drop fell. A heavy thunderstorm passed over Norwich on the 25th, but it did not extend to Brundall. This was the fringe of the terrific storm which visited the metropolis on the same day, when 2.66 in. of rain fell at Camden Square in an hour and a half!

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AUGUST.

Fineness and warmth were again the prevailing characteristics. With the exception of a quarter of an inch of rain which fell on the night of the 14th, and during the 15th, the month was rainless till the 25th, but notwithstanding some showers in the last week, the total rainfall of the month was under an inch. The 9th was the warmest day of the summer, although the maximum (83.5 degrees) fell short of the hottest days of the five previous years. By the end of the month the rainfall of the year was 4.45 in. deficient.

SEPTEMBER.

Although rain fell on twelve days, the falls were so slight that the month's total was no greater than that of August. The aggregate rainfall of the first nine months of 1901 was but 12.47 in., which was 6.25 in. below the average, and no similar period in any year since these observations were commenced gave so small an amount. The month was generally warm, and a fine protraction of summer, but by the end of the month the drought was becoming very seriously felt.

OCTOBER.

On the 1st the thermometer attained the unusually high October maximum of 75.5 degrees, but this warm outburst was followed by acceptable rains and stormy weather, accompanied by thunder and lightning on the 6th. During the second half of the month the falls of rain were very light, resulting in the monthly total being again deficient. The mean temperature was slightly above the average. There was an entire absence of frost until the 27th, on the morning of which day a rather sharp frost occurred.

NOVEMBER.

The weather generally was very changeable throughout the month, sunshine and gloom, fogs and gales, frosts and mildness, alternating in a remarkable manner. The month was, however, decidedly colder than any November since 1896, some of the night readings of the thermometer having been unusually low for so

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early in the season. Frost occurred on eleven nights as recorded by the screened instrument; the exposed thermometer registered frost on eighteen nights. A great downpour of rain occurred on the 13th, when 1.17 in. fell in twenty-four hours. Heavy gales were experienced on several days, that on the 13th, from the north, causing a direful disaster at Caister, when the lifeboat was upset and many lives lost. On the 20th, strong north winds brought up a very high tide, doing considerable damage on the coast.

December.

This was the first really wet month since August, 1900, the total being 4.14 in. falling on twenty days. A heavy downpour occurred on the night of the 12th—13th, 1.60 in. being recorded. This was the heaviest fall but two ever noted at this station, and was the maximum for the year. Gales and rough winds were experienced on many days, and some winterly weather occurred in the middle of the month. Although colder than the previous December, it cannot be called a severe month, the first and last weeks giving many mild days.

The Seasons.

The following Tables show the mean temperature and rainfall for the four seasons, together with those of the five previous years, and of a twenty-year approximate average. Winter comprises the three months, December to February inclusive; Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1896.	1897.	1898.	1899.	1900.	1901.	20-year average.	Departure of 1901 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	39.6	38.3	41.3	42.6	37.4	39.0	37.8	+ 1.2
Spring ...	48.0	46.9	45.8	46.2	45.3	46.3	46.2	+ 0.1
Summer ...	61.1	61.9	59.7	61.9	61.6	61.4	60.2	+ 1.2
Autumn ...	48.5	50.3	54.0	51.2	51.6	50.7	49.5	+ 1.2
Year	49.3	49.5	50.5	49.8	49.6	48.8	48.4	+ 0.4

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RAINFALL.

Seasons.	1896.	1897.	1898.	1899.	1900.	1901.	20-year average.	Departure of 1901 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	3.28	7.86	4.11	5.82	7.42	5.88	6.02	—0.14
Spring ...	5.18	5.05	6.18	6.84	4.26	5.10	5.21	—0.11
Summer ...	4.88	4.17	6.90	3.52	8.77	3.61	7.17	—3.56
Autumn ...	8.49	6.42	5.65	8.31	5.32	5.11	8.50	—3.39
Year ...	23.28	22.07	23.33	23.94	26.99	21.06	26.90	— 5.84

The mean temperature of the Winter was milder than the average, owing to the exceptionally warm December of the previous year. The latter part of the Winter was colder than usual. The Spring gave results approximating the mean, but the Summer and Autumn, for the third year in succession, were each of higher mean temperatures than the average. Rainfall was deficient in each quarter, although but slightly so in the Winter and Spring. The Summer quarter gave only about half of its usual rainfall, and the deficiency in the Autumn was also very large.

The Year.

The chief feature of the year was its great dryness, the total deficiency of rain to the end of November having been as much as 7.64 in., and that of the entire year 5.84 in. This was the more remarkable when it is remembered that there has been no year with an excessive rainfall since 1892, and six out of the eight previous years had given a deficient rainfall. Thunderstorms were very infrequent during the Summer, and it is singular that the most severe thunderstorm of the year occurred on January 28th, and was accompanied as above stated, by heavy snow and extreme darkness. While the Summer was as fine as could be wished for by the haymaker or the holidaymaker, the dryness left its mark over the face of the country generally, and the farmer and the gardener had many droughty difficulties to contend with. The fruit crop suffered severely, and the Apple crop in particular, which had been superabundant in the previous year, was extremely scanty throughout the county. The corn harvest began about August 1st, and the time for the ingathering was as fine as could be desired, the fields in most localities being cleared by the end of the month.

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1901.

Month.	Barometer. Highest.	Date.	Lowest.	Date.	Mean.	Thermometer. Highest.	Date.	Lowest.	Date.	Mean.	Hygrometer. Mean Relative Humidity, 9 a.m.	Cloud. Estimated proportion	Rainfall. Inches.	No. of days.	Wind. Direction. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W	Mean estimated force
Jan. .	30.60	23	29.15	27	30.013	53.0°	27	22.0°	9	37.9°	93	7.1	0.74	15	0	0	4	10	3	2	4	8	2.8
Feb. .	30.55	15	29.23	27	30.035	52 6	25	9.2	14	34.9	93	7.5	2.16	19	7	3	0	2	2	4	4	6	2.1
March	30.47	23	29.14	2	29.774	56.1	5	25.5	29	39.2	84	7.8	1.98	21	4	9	5	0	6	1	1	5	4.0
April	30.26	17	29.38	15	29.850	72.0	22	29.0	6	47.6	73	5.3	2.26	16	2	2	4	4	5	5	4	4	3 2
May .	30.46	12	29.29	7	30.111	76.7	28	33.4	18	52.1	77	5.4	0.86	9	3	10	7	2	1	3	2	3	3.1
June .	30.44	25	29.49	13	30.050	79.0	9	40.2	13	57.7	74	6.0	1.55	14	3	2	2	4	2	5	4	8	3.6
July .	30.31	17	29.58	25	30.021	83.3	21	46.8	10	63.7	72	5.1	1.19	6	4	3	9	6	1	1	2	5	2.3
Aug. .	30.45	21	29.86	26	30.024	83.5	9	45.0	28	62.7	75	5.3	0.87	9	4	4	1	2	1	3	7	9	3.0
Sept..	30.29	27	29.48	17	29.942	76.0	29	41.8	2	59.0	78	6.9	0.86	12	3	4	4	5	2	5	1	6	3.1
Oct. .	30.42	31	29.26	6	29.922	75.5	1	28.6	27	50.5	88	6.3	2 07	15	2	1	4	4	1	6	6	7	2.9
Nov. .	30.63	25	29.04	13	30.119	58.0	3	25.2	17	42.5	90	6.3	2.38	19	4	4	2	2	1	2	7	8	3.2
Dec. .	30.40	4	28.72	24	29.612	56.0	7	24.4	23	38.5	92	6.9	4.14	20	2	1	1	2	1	7	10	7	3.9
Means					29.956					48.8	82	6.3											3.1
Extremes & Totals	30.63	Nov. 25th	28.72	Dec. 24th		83.5	Aug. 9th	9.2	Feb. 14th				21.06	175	38	43	43	43	26	44	52	76	

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XVII.

VARIATIONS IN *RANUNCULUS FICARIA*, WITH SOME STATISTICS.

By W. A. Nicholson, *Hon. Sec.*

Read 25th February, 1902.

The subject of the variations of our common wild plants and animals is one fraught with special interest, not only for the field naturalist, but, as has been shown by some recent work, for the mathematician. I allude here, more particularly, to the writings of Professor Karl Pearson, F.R.S., who has treated variation and vital Statistics from the mathematical point of view. In his 'Grammar of Science,' 2nd ed. p. 374, he says: "Biologists, even as physicists have done, must throw aside merely verbal descriptions and seek in future quantitative precision for their ideas." Mr. Galton, Professor Weldon, and others, have also applied statistical methods to biology.

Figures and statistics may seem out of place in the transactions of a Naturalists' Society; but if they assist us in forming a truer idea of any fact in nature, we must not neglect them, however unattractive, at first sight, they may appear.

From Professor Pearson's point of view, in considering variations in biology, the important point is to measure the amount of variation, either by actual counting, or in other cases by exact measurements, of a large number of specimens. The average or mean is calculated, and, by a method frequently used in Statistics, the Standard Deviation, or amount of variation from the mean, is then worked out. The Standard Deviation affords a test of the amount of variation which any particular species is undergoing. I am not going into Professor Pearson's further applications of his methods, but would refer any one specially interested in this

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comparatively new development of scientific work, to consult his 'Grammar of Science,' already referred to. A quantitative study of a series of variations, in the same animal or plant, extended over a considerable period of time, would throw still more light on the trend of the variation. Hence, I venture to think, that the following tabulated results, might afford the necessary data for a comparison with results, in the same species, in, say, five years' or ten years' time.

The following notes constitute a record of actual cases of variation in the sepals and petals of a common wild flower, *Ranunculus ficaria*.

Towards the end of March, many of our commons and damp meadows are conspicuously ornamented with this handsome flower. As every one knows, it is seen at its best, with its starlike array of yellow petals fully expanded, in bright sunshine.

The great proportion of the specimens examined were growing in the Yare valley, from Keswick to Bramerton, a smaller number from Salhouse, on the Bure, the remainder coming from private gardens in or near Norwich. The total number of flowers tabulated amounts to 2116. Many more were examined, but had to be rejected, as being in a probably mutilated state. For instance, out of 97 specimens from Dr. Beverley's grounds, at Brundall, 19 were without any sepals, that is practically 20 per cent. As these were the only asepalous flowers found, I could only suppose that the sepals had been removed by some unknown agency. With the exception of one or two gatherings from private gardens, which belonged evidently to a fairly well marked variety, there is a remarkable sameness in the proportions of variations from the mode,* which, in the case of this flower, is 3 sepals and 8 petals. To take two instances, out of 187 flowers from Keswick common, 129 had 3 sepals and 8 petals; and out of 361 from Salhouse, 266 had 3 sepals and 8 petals. In the case of the garden variety, out of 110 flowers from Mr. Bidwell's garden at Thorpe, 77 had over 3 sepals, and 17 of these had 5 sepals.

There were 5 cases in all, in which 1 sepal sprang from the stem, $\frac{1}{4}$-inch below the others, in 4 of these cases, $\frac{1}{8}$-inch in 1. Also, in 5 cases, 1 sepal was partially petaloid, and, in 2 cases, 1 petal partially sepaloid. One specimen with 3 sepals and 10 petals, had

* It may be necessary to explain, that the term mode, in statistics, is used to denote the greatest number of cases, which occur in a group, and though near the average or mean, can never, if there is any variation, be identical with it.

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one of the sepals as long as the petals. The most curious variation found, was one in which the place of the third sepal was taken by an irregularly shaped foliage leaf.

The following tables which deal only with the ascertained number of sepals and petals in 2116 cases, show some interesting results :—

TABLE I.

TABLE SHOWING NO. OF SEPALS AND PETALS IN 2116 FLOWERS.

No. of Flowers.	Sepals.	Petals.	Totals of Groups.
3	2	7	
4	2	8	
1	2	10	8 with 2 Sepals.
1	3	5	
19	3	6	
168	3	7	
1262	3	8	
273	3	9	
75	3	10	
26	3	11	
4	3	12	1828 with 3 Sepals.
2	4	4	
4	4	5	
46	4	6	
78	4	7	
36	4	8	
21	4	9	
6	4	10	
1	4	11	
1	4	12	195 with 4 Sepals.
1	5	4	
17	5	5	
29	5	6	
9	5	7	
7	5	8	
9	5	9	
6	5	10	
6	5	11	
1	5	12	85 with 5 Sepals.
2116			2116

The figures in Table I. fall naturally into four groups. The 2-sepal group is too small in numbers, for the figures to be taken as anything more than accidental. But, in the three other groups, with the exception of a slight break in the 5-sepal group, there is a rise in the numbers up to the mode, succeeded by a fall. It is

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most pronounced in the 3-sepal group with 1262 flowers, with 8-petals, out of a total of 1828. An examination of the modes in the three groups shows that as the sepals increase the petals decrease. Thus, the modes are:—3 sepals, 8 petals; 4 sepals, 7 petals; 5 sepals, 6 petals, *i.e.*, in each case 11 perianth-leaves.

In Table II. the flowers are grouped according to number of perianth-leaves only.

TABLE II.

Nos.	Perianth-leaves.
3	8
27	9
235	10
1369	11
319	12
103	13
41	14
11	15
7	16
1	17
2116	Total.

The average number of Sepals ... 3.168
,, ,, Petals ... 8.036

The Standard Deviation from the mean worked out by the method recommended by Professor Pearson ('Grammar of Science,' 2nd ed. p. 387) is, for Sepals, ·4776; for Petals, ·9538. This may be taken as an approximate measure of the amount of variation from the mean.

The calculations for the Standard Deviations have been kindly verified for me by Mr. H. I. Whitty, M.A., and Mr. J. H. Gwillim, M.A.

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XVIII.

LIST OF ROTIFERA FROM YARMOUTH DISTRICT.

By H. E. Hurrell.

Read 25th February, 1902.

On account of their habits, and form of locomotion, Rotifers have been divided into the following orders, viz. :—

ORDER I.—Rhizota, or Fixed species.

ORDER II.—Bdelloida, or those Creeping like a leech.

ORDER III.—Ploïma, or those Swimming by means of the crown of cilia with which they are furnished.

ORDER IV.—Scirtopoda. Swimming as Ploïma and also skipping. This order at present contains but two species, neither of which has been found in this district.

The following species have all been found by myself during the years 1900—1901.

ROTATORIA.

Order I.—RHIZOTA.

Flosculariadæ.

Floscularia ornata. Ditches, Southtown and Cobholm.

Campanulata.

Stephanoceros eichornii. River Waveney at Beccles.

Melicertidæ.

Melicerta ringens. River Yare, Brundall.
Lacinularia socialis. River Waveney at St. Olaves.
Megalotrocha albo-flavicans. River Waveney at Beccles.
Limnias ceratophylli. River Waveney at Beccles.
Œcistes crystallinus. Various.
Conochilus volvox. Ormesby Broad.
,, unicornis. ,,

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Order II.—BDELLOIDA.

Philodinadæ.

Philodina citrina, „ roseola, Rotifer vulgaris — Various ditches at Caister.
„ tardus. Pond near Great Ormesby.
Actinurus neptunius. „ „

Order III.—PLOÏMA.

Microcodidæ.

Microcodon clavus. *Own Tank.*

Il-Loricata.

Asplanchnidæ.

Asplanchna brightwellii. Ormesby Broad.

Synchætadæ.

Synchæta pectinata, „ tavina, „ gyrina — Brackish ditches, Acle New Road, Yarmouth.
„ tremula, „ cecilia — Ditches, Caister Road, Yarmouth.

Triarthradæ.

Triarthra longiseta. Ormesby Broad.
„ breviseta. „ „

Hydatinadæ.

Hydatina senta. Ditch, Caister Road; Ponds at Caister and Scratby.
Rhinops vitrea. Ditch, Caister Road; and Pond, Burgh St. Peter

Notommatadæ.

Notommata ansata. Caister Road.
Furcularia longiseta. „
„ gibba. „
Diglena grandis. „

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Sub-Order.—LORICATA.

Rattulidæ.

Mastigocera elongata. Caister ditches.
Stephanops lamellaris. „

Dinocharidæ.

Dinocharis pocillum. Caister Road marshes.

Salpinadæ.

Diaschiza semiaperta. Caister Road marshes.

Euchlanidæ.

Euchlanis dilatata. Caister Road marshes.

Cathypnadæ.

Monostyla cornuta.

Pterodinadæ.

Pterodina patina. Ormesby Broad.
„ mucronata. „
„ elliptica. Cobholm, Yarmouth.
Pompholyx sulcata. Ormesby Broad.

Brachionidæ.

Brachionus pala. Ormesby and Belton.
„ mullerii. Acle New Road, Yarmouth.
„ rubens. Dunston.
„ angularis. Scratby.
„ urceolaris. Ormesby.
„ bakeri. Ditches at Yarmouth.

Anuræadæ.

Anuræa aculeata. Ormesby Broad.
„ cochlearis. Chalk-pit at Gunton.
Notholca longispina. } Ormesby Broad, Fritton Lake, and probably all inland waters of this kind.
„ acuminata. }
„ scapha. } Ditches at Southtown, Cobholm, and Caister Road, Yarmouth.
„ labis. }

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XIX.

ON THE TINCTORIAL PROPERTIES OF OUR BRITISH DYE PLANTS.

By C. B. Plowright, M.D.

Read 25th March, 1902.

The use of native plants for tinctorial purposes in Northern Europe was at one time considerable, for the sparse population resided in places far removed from the great centres of civilization. The impetus which the writings of Linnæus gave to the study of botany during the eighteenth century, was felt not only in Scandinavia but more or less all over the world. Botanists were induced to record their observations on all matters connected with plant-life, and especially the economic points of interest attached to plants. Naturally their uses for dyeing purposes were observed and commented upon. Lists of the dye plants of Iceland and Sweden were published by Svenonius, Ullgren and Jörlin, the gist of which found its way into the earlier editions of Withering's British Plants, together with the observations on the same subject by Pennant, Lightfoot, and Rutty, in our own country. The fact, too, that some of these plants are still used in the Highlands of Scotland and in some parts of Ireland, induced me to undertake a series of experiments, in which the properties of each species have been practically put to the test upon skeins of white wool. Each of these skeins has been divided, one series has been given to the Royal Herbarium at Kew, another to the Dublin Herbarium, a third to the City of Glasgow Technical School, while a fourth is exhibited to the members of the Norfolk and Norwich Naturalists' Society to-night.

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The plants, phanerogams and cryptogams examined, number some 68 or 70. They have produced about 150 different shades of colour. No attempt has been made to test their tinctorial properties with the more modern mordants, but only such simple substances as alum, ammonia, lime, potash, and iron sulphate have been used, such in fact as our ancestors could have employed. The reason for this was to see what shades and colours our ancestors had to be content with, before the introduction into common use of exotic dye plants. The general outcome of these experiments is this, first, that all the tints and colours which were obtainable from British dye plants were essentially of a sombre hue. In actual number the yellows exceed all others. Of these yellows, one or two were so good that they continued in use until within the last half century. Then again no bright permanent red can be produced from any British plant. The brilliant hues which some of the lichens yield, could not by any process known to our ancestors be rendered fast against sunlight. The only blue colour they possessed was that of Woad (*Isatis tinctoria*), a colour of great beauty and durability, but one exceedingly difficult to extract from the plant. Although a colour of prehistoric origin, yet it is one which to-day can only be obtained by the most careful management. In point of fact the discovery, that *Isatis tinctoria* was capable of dyeing wool blue, was as great a marvel in its way as the discovery of the art of producing fire. The useful colours, the browns and blacks, tannin derivatives, are obtainable from various barks and roots: Oak, Alder, Walnut, Water Lily, Tormentil, &c., while some of the Lichens yield browns of great beauty. These colours are still made use of in Scotland.

In the subjoined enumeration, a summary of the results obtained is given, which it is hoped may be of interest, not only from a botanical, but also from an archæological stand-point. I am much indebted for help to many friends who have aided me in the collection of material, and in many ways. Sir Thomas Wardle of Leek has helped me with suggestions and advice; Mr. A. G. Perkin (A.G.P.) with the chemistry of the subject; and Messrs. Angus Grant of Drumnadrochit, R. V. Tellan of Bodmin, J. Martindale of Kendal, G. F. Scott Elliott of Glasgow, Carleton Rea of Worcester, H. Huff of Wormegay, E. M. Holmes, F.L.S., of the Pharmaceutical

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Society, W. Phillips, F.L.S., of Shrewsbury, Rev. Dr. Keith of Forres, and Rev. D. McDougal of Rothiemurchus, with specimens and materials for experiment.

List of British Dye-Plants and results obtained.

Thalictrum flavum.—Gives a poor yellow with alum.

Caltha palustris.—The flowers, yellow with alum.

Berberis vulgaris.—The inner bark and the bark of the roots, yellow with alum. The colour is due to berberin.

Nymphæa alba. The rhizome gives a nice brown, with and without alum. This was found in use in the Hebrides, by Pennant, in 1782.

Isatis tinctoria.—Is capable of yielding a number of colours. The flowers, with alum, dye wool a pale yellow. The fresh green leaves, boiled with wool, impart a reddish-brown to it. The blue colour, however, which is so essentially associated with Woad, is not readily yielded by it. This blue colour is really indigo, but it exists in the plant in such an unstable state that it can only be extracted with great difficulty. Its presence may however be demonstrated in the following manner:—Pour boiling water on fresh leaves of the first season's plants. When cold, pour off the water, add a little caustic potash; dip a piece of wool in this, and then immerse it in dilute hydrochloric or sulphuric acid. The wool will at once assume a more or less blue tint. The great difficulty is that the pouring off the infusion, and the dipping the wool into it, causes the unstable indoxyl, by the action of the air to pass into other products which are not indigo. For actual dyeing, the fresh green leaves are crushed into a pulp in a mill, the mass made into balls, which are dried; these are re-crushed, wetted, allowed to ferment, and finally made into a paste of a brownish hue, emitting a penetrating ammoniacal odour. The process of manufacture is given in full by Mr. Corder, in his excellent paper in the 'Transactions,' 1890, vol. v. p. 144. The Woad in this state contains no indigo, but if it be mixed with water and maintained from fifteen or twenty hours at a temperature of 120° to 150° F., a certain amount of indigo is formed. The addition of a minute quantity of slaked lime, a mere trace, just enough to make the

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solution alkaline, causes the indigo to dissolve: wool now immersed and left in the mixture for an hour or two is dyed blue: that is to say, it becomes blue when taken out and exposed to the air. Not only does the mixture of Woad and water, maintained at the above-named temperature, produce a small quantity of indigo, but what is of practical use, it is capable of dissolving exotic indigo. This process is still in use in Leeds, where the really woaded blue cloths are dyed, that is to say, cloths dyed with indigo dissolved by the means of Woad.

With various yellows, Woad gives shades of green. Specimens of greens produced by the subsequent application of Ash bark, Crab-apple bark, Weld, Dock, and *Genista tinctoria* will be found.

With Cudbear from *Lecanora tartarea* a deep purple is formed. In bygone times Woad was used to form the basis of many colours. For instance, blacks, these were first dyed blue with Woad, and subsequently immersed in a vat of logwood, tannin, and iron.

Reseda luteola.—This plant, with alum, produces the best and most permanent yellow of all our native plants. It has been used within the last quarter of a century for that purpose by dyers. The yellow is deepened by alkalies and rendered brown by iron. It is due to luteolin.

Hypericum perforatum.—Fresh and dry with alum, and with or without subsequent treatment with ammonia, dyed wool greenish and brown. Four specimens are shown.

Rhamnus frangula.—The bark with alum gives a nice orange brown.

Rhamnus catharticus.—The fresh berries give, with alum, a dull green; the bark a rich brown.

Genista tinctoria.—Another dye plant, used in comparatively recent times, yielded various shades of yellow with alum; permanent, but lacking the beauty of those produced by *Reseda*. These yellows are darkened by alkalies. This plant was said to give better greens—hence its name "Dyer's Green Weed"—than Weld. It contains luteolin, $C_{15}H_{10}O_6$, and genistin, $C_{14}H_{10}O_5$, according to the researches of Mr. Perkin. It was formerly used for the production of the celebrated "Kendal Green," mentioned by Shakespeare.

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GENISTA ANGLICA.—The flowers give a very delicate yellow, with alum, which darkens very considerably by treatment with ammonia.

ULEX EUROPÆUS.—A much paler yellow, with alum.

ANTHYLLIS VULNERARIA.—The fresh flower-heads gave, with alum, a good yellow.

TRIFOLIUM PRATENSIS.—Fresh flower-heads, with alum, a pale yellow; with iron (copperas), a yellow green.

PRUNUS SPINOSA.—The ripe fruit, with alum, gave a pale mauve, or dirty fawn, which is darkened by copperas, and turned green by alkalies. The bark dyes a yellowish brown with and without alum.

PYRUS COMMUNIS.—Dried pear leaves, with alum, dyed wool yellowish; with copperas, greenish black.

PYRUS MALUS.—The inner bark gives one of most beautiful yellows, darkened by ammonia.

RUBUS FRUTICOSUS.—The mixed ripe and unripe fruit give a slaty blue, with alum, of doubtful durability. This colour was altered but not blackened by iron.

TORMENTILLA OFFICINALIS.—The rhizome, which is so rich in tannin that it has been used for making leather, dyes brown with alum; but by treatment with potash this assumes a reddish tint—not a true red, but rather the reddish brown of burnt sienna. Linnæus in his tour in Lapland found the natives dressed in woollen garments, dyed red, which they told him was effected by the use of this plant. This, they said, consisted in chewing the rhizome and applying the saliva to the wool. They probably imposed upon his credulity, or else he misunderstood them, for so far as my experiments have gone, saliva has no action of this kind on the root of this plant.

COMARUM PALUSTRE.—Has very similar properties to Potentilla; prolonged boiling with copperas, however, imparts a deep red brown—a chocolate brown—to wool.

SPIRÆA ULMARIA—Also a rhizome rich in tannin, gives shades of brown, red-brown, and brown-black on treatment with the various mordants above mentioned.

CHÆROPHYLLUM SYLVESTRE.—With alum gives yellow and yellow-green, according as the umbels or stems and leaves are used.

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CORNUS SANGUINEA.—The fresh ripe berries, with alum, dyed wool a distinct but not brilliant yellow.

GALIUM VERUM.—Is a plant capable of yielding several colours. The flowers, with alum, yellow; the rhizome, which is very much larger than one would have expected, shades of reddish-brown, deepened by treatment with potash, and orange. The distinctive madder tints were not elicited. It has been stated that the allied species, *G. aparine*, *boreale*, etc., also possess tinctorial qualities. These, however, were not tested. The colouring matter is probably ruberythric acid, $C_{26}H_{28}O_{14}$.

SCABIOSA SUCCISA.—A not very clear yellow, with alum.

BIDENS TRIPARTITA.—A by no means abundant plant; gives a brilliant orange to wool that has been boiled with the fresh plant and then immersed in a solution of alum.

ANTHEMIS TINCTORIA.—As its name would imply, gives a good permanent yellow with alum.

CHRYSANTHEMUM SEGETUM.—The fresh flower-heads give, with alum, a dark yellow, deepened by alkalies. The tinctorial principle is chrysanthemin, $C_{14}H_{28}N_2O_3$. (A. G. P.).

SENECIO JACOBÆA.—The whole plant, but especially the flower-heads, gives, with alum, a good fast yellow. This plant is still used in the Highlands of Scotland for producing green with indigo.

SERRATULA TINCTORIA.—Gives, with alum, a nice clear yellow.

TANACETUM VULGARE.—A very similar yellow to the above, due to tanacetin, $C_{11}H_{16}O_4$. (A. G. P.).

XANTHIUM STRUMARIUM.—Although not indigenous, is mentioned by Withering. It gives a pale canary yellow of considerable beauty, with alum. There is no indication of the property in the plant as it grows; but it is said that the ancients were acquainted with it.

CALENDULA OFFICINALIS.—Also in Withering's list. The flower-heads, in spite of their deep colour, gave hardly any colour at all.

EMPETRUM NIGRUM.—The ripe fruit, with alum, gives shades of mauve, rendered bluish by ammonia.

CALLUNA VULGARIS.—Still largely used in Scotland to impart a yellow-brown to wool. The process employed is simple: The

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flowery tops of the heather are packed with the wool, stratum super stratum, in a saucepan of sufficient size; water is poured in and the whole boiled briskly. It contains quercetin, $C_{15}H_{10}O_7$. (A. G. P.).

ARCTOSTAPHYLOS UVA-URSI.—The dried leaves, when boiled with alum and wool, impart a yellow colour to the latter. The addition of sulphate of iron produces a slate colour. Mr. Perkins informs me that quercetin ($C_{15}H_{10}O_7$) and myricetin ($C_{15}H_{10}O_8$) are contained in this plant.

LIGUSTRUM VULGARE.—The deep purple-black berries of the common Privet dye wool green when boiled with alum. They contain ligustrin.

FRAXINUS EXCELSIOR.—The inner bark of the younger branches, with alum, dyes wool yellow, verging to brown. It contains fraxin ($C_{14}H_{18}O_{10}$), a glucoside of fraxetin ($C_{10}H_8O_5$). (A. G. P.)

LYCOPUS EUROPÆUS.—With alum this plant gives a greenish colour to wool boiled with it; with copperas (F_2SO_4), a blackish.

ORIGANUM VULGARE.—The assertion that the tops will dye purple was found to be incorrect; on the contrary, they gave, with alum, a good yellow, darkened by alkalies.

STACHYS SYLVATICA.—With alum gave a pale yellow, a dirty yellow, and a pale brown.

STACHYS PALUSTRIS.—With alum gave a pale yellow-brown.

RUMEX CRISPUS
„ OBTUSIFOLIUS } The roots, when boiled, gave a variety of colours. Five specimens are shown. With alum a pale yellow, which treated with potash assumed a salmon or reddish; while with iron, shades of grey and greenish-grey were obtained. The roots contain quercetin, $C_{15}H_{10}O_7$. (A. G. P.).

RUMEX ACETOSA—The roots, with alum, gave a very pale yellow.

POLYGONUM PERSICARIA.—A very good yellow, with alum.

„ HYDROPIPER.—A rather darker yellow than the above, which became olive when treated with iron.

URTICA DIOICA.—In spite of the assertions of the older writers, no colour could be obtained from the roots of this plant. Trials were made both during the summer and the winter months.

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HUMULUS LUPULUS.—Gave a very fair yellow with alum; the young tips were used.

SALIX TRIANDRA.—The dried leaves are said to give a yellow; in this I was not very successful, but with copperas they gave a yellowish-black.

SALIX CINEREA.—The leaves gave a pale yellow-brown, reddened by potash.

QUERCUS ROBUR.—The bark gave a pale red-brown with alum; with copperas a purple-black.

CARPINUS BETULUS.—The young bark gathered in autumn, and also in spring, gave only a pale brown—not a distinct yellow, as one would expect from the older writers.

BETULA ALBA.—Six patterns are shown. The leaves give a good yellow, with alum; the bark, pale brown—a reddish brown; and, with potash, a distinct rufous. The bark contains betulin, $C_6H_6O_2$ (A. G. P.).

ALNUS GLUTINOSA.—A dozen patterns are shown. One yellow, from the catkins, with alum; the others, from the bark, brown, dark brown, red-brown, reddish, greenish-grey,—purple, grey, chocolate, and black-brown, by the action of potash and iron. Although not strictly within the limits of this set of experiments, a very good black was obtained from the bark with bichromate of potash, but this was a salt not available by the ancients. The bark contains alder tannin, $C_{27}H_{28}O_{11}$.

MYRICA GALE.—The whole plant, with alum, gave a dirty yellow, or pale yellowish brown.

JUGLANS REGIA.—Although the walnut is not a native British plant, yet it has been grown in this country for a long time. The green husks have been used by dyers until quite recently. They require no mordant, and impart a rich permanent brown to wool. A pale shade, with a suggestion of pink, is given to the later "dip." It contains nucitannic acid.

IRIS PSEUDACORUS.—The rhizome, when boiled with wool for a prolonged period, imparts to it a brown colour.

PHRAGMITES COMMUNIS.—The fresh young flower-heads give, with iron, a peculiar green.

STICTA PULMONARIA.—Gives a rich chestnut brown.

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PARMELIA CAPERATA
„ SAXATILIS
„ PHYSODES
„ BORRERI

When fresh, these Lichens all give good browns when boiled with wool. They require no mordant. Maceration of *P. saxatilis*, with ammonia, and also with urine for prolonged periods, produced no red colour.

PHYSCIA FLAVICANS.—This gives only a pale yellowish-brown of no great beauty. The *Lichen vulpinus* of Linnæus does give a beautiful lemon-yellow, but this is not a British species.

PHYSCIA PARIETINA.—Gives, in spite of its rich orange-yellow colour, only a pale brown. By the action of alkalies it yields a dirty brown with the barest suggestion of red.

UMBILICARIA POLYPHYLLA
LECANORA TARTAREA
URCEOLARIA SCRUPOSA

All three species, when macerated in water containing ammonia, produced cudbear. As far as I could judge, the colours were practically identical; red when finished in an alum or tin solution, purple when treated with an alkali. The colours are beautiful, but evanescent. The colouring matter is orcein, $C_7H_7NO_3$.

POLYPORUS HISPIDUS.—This fungus has been used for dyeing by our ancestors: boiled with alum it dyed wool a good yellow-brown.

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XX.

NATURAL HISTORY NOTES FROM YARMOUTH.

By A. Patterson.

Read 25th March, 1902.

1901—1902.

Almost the last arrival at Durrant's game stall in the March of 1901 was a ♀ Wigeon, which had partly assumed the markings of the male.

A Spoonbill was seen on Breydon, April 10th, the first of a considerable number which visited the mud-flats that year. A flock of twelve put in an appearance on April 27th; these were joined on the 28th by five others, which stayed only a few hours. After that time, a day seldom passed without one or more being seen contentedly gleaning a living at the water-margin, or sleeping unsuspiciously in the company of the Gulls higher up the flats. Wary as the Spoonbill is, I could on several occasions have easily sculled to within shooting distance.

On or about April 22nd six Herons passed overhead, making due N.E., seawards. I am of opinion that some of these birds leave this country, having observed similar exits; and am almost as certain that *male* birds occasionally put in an appearance from abroad, having rowed within almost oar's length of magnificent fellows fast asleep in the month of April, they having every appearance of tired-out arrivals. I have seen Grey Plovers drop down on a flat and fall fast asleep at that season.

May 11th. Several Wimbrel on Breydon.

May 13th. An Æsop's Prawn (*Pandalus annulicornis*) brought me. The carapace was covered with a somewhat compact form of Acorn Barnacle.

May 13th. An 8-inch Power Cod (*Gadus minutus*) taken in a shrimp-net.

On May 16th, after some manœuvring, I got fairly close to a flock

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of ten Gadwalls (*Anas strepera*) on Breydon. It is a long time since I saw a Gadwall on Breydon. It was a very bitter day; I sat in the boat and shook with the cold, but the sight of two Spoonbills and three Greenshanks amply repaid me. These Spoonbills alighted close to the watcher's house-boat; and he told me he observed them catching and trying to swallow "penny-sized Butts," but they could not "take 'em down." The Gulls however did this for them.

May 18th. A Spotted Ray (*Raii maculata*), the disc of which equalled a dinner-plate in size, had a fin of the size of a business envelope placed vertically on the upper surface, or "back," exactly in the position of a dorsal fin.

CRAB-DEFORMITIES. During the summer I met with one or two Crabs possessing oddly shapen chelæ. One had the free point of the large pincer claw enlarged by a round knob in addition to the *toothed* part. Another had three points to the end of one of the small claws. A third larger pincer claw had the fixed point peculiarly broadened and "sprayed" like so many fingers.

On May 21st a 90 lb. Opah (*Lampris luna*) arrived on the Wharf *from Shields:* it had the appearance of having been taken in a trawl-net.

In the first week of June an Angler-fish (*Lophius piscatorius*) was observed in distress near the Ferry. It was adroitly gaffed and landed by means of one of the life-poles hung on the posts hard-by. It measured two feet in length.

A very fine Crucian Carp (*Cyprinus carassius*), at a guess, about a pound in weight, was taken at Potter Heigham during the first week in June.

On June 15th five Spoonbills passed over my head in single file. They used the Burgh marshes, alternately with Breydon flats, for some days. I do not think any were shot this year. The watcher, Jary, was indefatigable.

June 26th. Some quite baby Herons on Breydon near my house-boat.

June 27th. About sixty Redshanks around my "corner." The extended close season has come as a god-send to this species, the unwary young of which used to be very nearly exterminated in the month of August.

Greenshanks were plentiful during the second week in July, and on the 25th no less than eleven were seen together.

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On July 14th a 14-inch Mackerel was saved for me by a friendly fish merchant; the back of it was entirely blue, save in a certain light, when faint fine lines, like "watered silk," were just discernible.

On July 21st, with Mr. Eldred, I had a row round Breydon. We saw two or three Curlew-Sandpipers, two Spoonbills, a Caspian Tern, and a Sandwich Tern. The latter was resting on a stranded basket; and the Caspian fishing, plunging into the water with the dash and vigour of an Osprey.

In the end of July two Avocets were here. One was shot on the North River. They were exceedingly tame and unsuspicious.

August 18th. A score Lesser Terns noisily flying about on Breydon. They kept in the neighbourhood several days.

On August 24th a Green Sandpiper (*Totanus ochropus*) passed me. For some unaccountable reason this species has become singularly scarce here during recent years.

A few little Stints in neighbourhood early in September.

The principal event of the month of September was the decided immigration of Redstarts, Pied Flycatchers, and Siskins, the latter not having been so numerous for several years. A birdcatcher, observing a great number of Siskins feeding on an old lettuce bed, borrowed a caged Siskin, and set his nets early next morning. By breakfast he had netted 90, and 140 by eleven o'clock. He sold them at one shilling a male bird, and twopence each the hens.

On September 22nd a young Crested Grebe was slightly wing-tipped on Breydon, but did not appear to be otherwise injured. I placed it in an aviary with some Gulls, which it most viciously pecked at on their approach. The bird pushed itself along on its breast in a peculiarly awkward fashion; hitching itself forward in an undulating manner by its widely spread legs. With me it remained very spiteful, and pinched and pecked my hands in a most vicious manner. It did not take very kindly to food although the end of a strip of fish, once in its mandibles, it took good care to gobble up the remainder. I sent it to the Zoological Society's Gardens, where it died on arrival.

On October 16th a live Storm Petrel was brought in by a Herring-fisher. Observing a group of fishermen highly interested in the contents of a *paper pastry bog* I went to look, when the head of the poor little Petrel popped out. I purchased it, and took it home, where it soon learnt to peck at soft Herring-milts hung

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within its reach. It would run up and down with its wings raised vertically, uttering a peepy cry, very like that of a newly-hatched Turkey chick. It lived only a few days with me. A second was brought alive to the Wharf, a day or two after, which I did not purchase.

I found a Jelly-fish, which I believed to be *Rhizostoma cuvieri*, at the Harbour mouth in the middle of October.

October 22nd. A "Jackdaw" day! Flocks coming in.

Kingfishers, I think, turned up more numerously in September and October than usual.

October 27th. Twenty-four Scaups passed over my head on Breydon, wind S.W. Most of the more noticeable migratorial movements appear to have occurred on this wind this year.

Quite a glut of immigrating Lapwings on the same date: this species invariably seem to arrive with a tired air, being usually well-fleshed and heavy, and not so strong on the wing as its sharper pinioned *confrères* the Grey and Golden Plovers.

October 27th. One Wimbrel and some Redshanks on Breydon.

October 31st. A well-plumaged ♂ Great Grey Shrike flew aboard the Steam Drifter "17," but died from exhaustion and want of proper food.

During the first week in November many thousands of *Macra stultorum* (Radiated Trough Shell) were washed ashore at Gorleston, with numbers of Starfishes, *Uraster rubens*, *Solaster papposa*, and *Orphiocoma rosula*. Wind E., strong.

An Anchovy taken on or about November 2nd. The following entry in my note-book is worthy of notice:—

November 12th. "Glass falling rapidly. Gale came on at night."

" 13th. "During a lull in the gale last night, the air overhead was alive with Golden Plovers and other migrating waders, wind-muddled and light-attracted. Some Snipe were distinctly heard among them."

During the second week in November, I saw an Octopus (*Octopus vulgaris*) on board a lugger that had been caught entangled in the nets. The body was the size of a lemon with tentacles of about a foot in length. This is an unusual catch, especially so near the surface.

November 16th. Wind E.N.E. Fine, but very wild sky, huge red clouds like mountain ranges made the firmament grandly wild.

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Went on Breydon, seeing 45 Geese noisily come towards the flats, and then strike off to the marshes. Three Swans, probably Whoopers, flew past me. Their note was a bad imitation of that of the Curlew! Hundreds of Golden Plover and Lapwings all leading N.W.

A live Guillemot, picked out of the river, brought me. I forced it to feed, and although lively and vicious, it died during the night. It seems almost impossible to get these birds to recover after getting into the breakers, as they do when exhausted by the continuous buffetings of the ocean. Another brought to me on November 25th. This died also. It repeatedly uttered a croaking note not unlike the "caw" of a Rook.

In the middle of November a Waxwing invasion occurred. Several reported to me as having been seen at Filby and the surrounding villages. They were as tame as Doves: hence they were ruthlessly slaughtered. A birdcatcher shot one, and described it as being "full up with butter-haws" (Hawthorn berries).

On November 26th a fine Scribbled Mackerel came into my possession. Length 15 inches. Forwarded to Norwich Museum.

December 18th. Number of Coots on Breydon, and several Redshanks.

1902.

January 1st. I went for a sail on Breydon. Observed several Linnets on the "Lumps," in company with Larks. I was much interested in their doings, having observed them frequenting this place on several occasions. From what I saw of them, I feel almost convinced it was upon the shrivelled remnants of the Glasswort (*Salicornia herbacea*) that they were feeding.

On the same date an Allen's Porphyrio was obtained at sea (see 'Zoologist,' March, 1902, p. 98).

I obtained a fine example of a Hybrid "Turbot-Brill;" a fish exhibiting a decided combination of the two species. The head was that of a Turbot, the upper surface coloured exactly like the Brill; whilst there was an entire absence of the spines which distinguish the former. It is now in the Natural History Museum, South Kensington.

January 29th. A double-sexed Herring was opened by Mr. Blanchflower's potting firm. The roe and milt were those of

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an adult fish. The anterior portion, for three-fourths of the length, was roe, the milt being wedged into the lobes of ova.

Goldfinches unusually common around Acle during the latter part of January.

On February 26th I found on a fish-hawker's barrow, a Plaice, about the size of my hand; the anterior half of the upper surface was of the normal colour, the latter portion being white with faint orange spots dotted here and there. I made a sketch of it. Singularly enough, on meeting with this same fish-hawker a fortnight after, and on overhauling his "wares," I found another correspondingly variegated. This points to a probable brood of fishes exhibiting this strange admixture of colouration, all doubtless related.

More Wild-fowl have been seen in this immediate neighbourhood since February 1st than during all the preceding winter. I refer more especially to Ducks. A Pochard or two on the 1st in the market.

The bird-catching prosecution of the 3rd February has caused consternation amongst the local bird-catching fraternity.

March 1st. Like summer-time on Breydon. A considerable number of Ringed Plovers on the flats, the advanced contingent of spring-wader migrants.

I have for a considerable period tried to detect the Hooded Crow in search of Mussels, but so far without avail. As a matter of fact, at low tide this bird frequently pulls these Molluscs from the little stone and shell covered patches in the drains left at low water. Then flying towards the Breydon stone walls it lets the Mussel drop in order to break it, and then descends to pick it up, taking it upon the grass-covered wall and leisurely devouring it. Near my house-boat the walls are sprinkled with the broken valves. In course of conversation with old Breydoners on this subject they distinctly affirm that "Hoodie" was often seen in their gunning days to search for Mussels when hard put to, and mounting with them would drop them on the ice. Failing a first successful fall, the bird would mount still higher until its object was obtained, namely, the breaking of the shell.

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XXI.

THE SOILS AND SUBSOILS OF NORFOLK.

By Horace B. Woodward, F.R.S., F.G.S.

Read 25th March, 1902.

The subject of Soils seems to become more complex according to the attention bestowed upon it. To estimate fully the agricultural capabilities of an estate, it is not enough to know the general characters and depth of the soils, to have chemical analyses of them, and to be acquainted with the nature of the subsoils, while due heed is given to the conditions of elevation, aspect, and rainfall. We must also have "mechanical analyses" of the soils, or a determination of the size and composition of their finer constituents, as the available plant food, or, in other words, the natural fertility of the soil, is largely dependent upon its texture. Thus many matters have to be considered by those who judge of the changes likely to be brought about by the application of manures and the influence of micro-organisms.

In justification of this detailed research, it has been urged that the results give us "complete control over the fertility of a soil in so far as this depends on manuring;" and that, consequently, "our views as to the value of agricultural land have completely changed, for whereas, formerly, sandy soils were generally considered poor, they are now, by means of a system of intelligently directed manuring, made to give yields which are scarcely inferior to those of the best soils."*

Views of this kind are not altogether new in Norfolk where the system of marling the land was adopted two centuries ago with conspicuous advantage in certain areas; and as Arthur Young remarked: "A country of rabbits and sheep-walk has been covered with some of the finest corn in the world."† Circumstances,

* Address by Professor Maercker to the German Chemical Society, reported in 'Nature,' Nov. 30th, 1899, p. 116; see also 'Lectures on some of the Physical Properties of Soil,' by R. Warington, 1900.

† 'General View of the Agriculture of Norfolk,' 1804, p. 3.

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however, have so changed with the increased cost of labour and the introduction of artificial manures, that there is more need than ever of the union of science with practice.

To gather the full information suggested by modern research even over the limits of a parish would involve, perhaps, more expense than the landowners and farmers might be disposed to defray. Detailed investigations of soils and subsoils have, however, been carried on with State aid in Germany, in the United States, and elsewhere; while in England, apart from the important personally-conducted experiments of Gilbert and Lawes on the influence of manures on particular soils and crops, special studies of soils have been commenced at the Reading College under the direction of Mr. Douglas A. Gilchrist.*

Perhaps the most serious question is the number of observations necessary to give a fair notion of the quality of the soil. In some localities the soil varies much within the space of one field. It may, therefore, be useful to review the relationship between soil and subsoil, with especial reference to Norfolk; for if soils are mainly dependent on the subsoils, a geological map, on which these are depicted with the highest possible accuracy, should serve as a basis for soil investigation. Moreover, the conditions under which soils were accumulated is a subject which rightly comes within the purview of the geologist.

Strictly speaking, the subsoil is the geological formation which lies immediately beneath the soil, although the term has sometimes been restricted to the weathered and disintegrated portions of the subjacent rock. This restriction cannot, however, be maintained. On the chalk formation, for instance, the soil is sometimes exceedingly thin; a ploughed field may look brown and loamy, but an adjacent chalk-pit may show but a few inches, or hardly a perceptible trace of soil. In such instances the chalk is clearly the subsoil. On stiff clays again there is often but a skimming of soil. This is the case in areas of London Clay, and it may be experienced in some London gardens where London Clay is distinctly the subsoil. On such formations the purely indigenous soil is apt to be thin; but everywhere the thickness of soil depends very much on the physical features, for in heavy rain the soil on sloping arable lands may be partially washed downhill, the streams are rendered turbid, and a film of sediment may be spread over

* A First Report on the Soils of Dorset was issued in 1899.

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the alluvial flats if the rivers overflow their banks. Clay-vales locally have their heavy soils ameliorated by downwashes of lighter materials from bordering hills, so that on isolated hills and on the brows of uplands less soil and a less amount of weathered subsoil are to be expected than on plateaus or in vales.

That subsoils possess infinite variety in structure and composition may be gathered from a study of the lithological characters of the many geological formations, which include limestone, slate, sandstone, conglomerate and other hard rocks, as well as marl, clay, loam, sand, gravel, and other soft and loose materials. Some formations are fairly uniform masses of strata of considerable thickness, others exhibit great diversity of character within narrow limits. All are more or less subject to modification where they approach the surface, through the influence of frost and rain: harder rocks are broken up, calcareous rocks are partially dissolved away, while those which are grey or dark blue at a depth become a rusty brown through decomposition of the iron-salts which they contain. The depth of the weathered rock beneath the actual soil varies considerably in different areas even on formations of similar age and character. This is to some extent owing to geological changes, but mainly to the nature of the ground. Thus chalky Boulder Clay and shelly Crag, which are usually decalcified near the surface, are sometimes turned up by deep ploughing in situations where but little weathered rock or soil can accumulate.

In the southern counties of England we find in places greater thicknesses of weathered rock than to the north and east, in regions where the land in Pleistocene times was overspread by a mantle of ice which incorporated the ancient soils and subsoils with erratic detritus, and worked up all the debris into the newer formations known as Glacial Drifts. These Drifts, which are of very mixed composition, have been distributed over much of Norfolk, and to them the diversity and natural fertility of the soils are principally due. The soils in Norfolk have thus resulted from the modification of the surface after the period of great cold, and, indeed, after the torrential action which, following the melting of the ice, spread out accumulations of boulder gravel, furrowed the surface, and marked out the courses of the streams. The later erosion, when the area had been subjected to depression, has been carried on by frost, rain, and streams, and it has been more directly influenced, not only by the physical features, but by the porous or

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impervious nature of the surface-deposits, and by the growth of vegetation.

The soil is the top covering of earth from a few inches to a foot or more in depth, made up most largely of the weathered subsoils, with an admixture of decayed animal and vegetable matter or humus, and with a certain amount of wind-drifted material, the whole acted upon in various ways by plant-growth, earthworms, and other organisms.

In endeavouring to estimate the extent to which soils owe their mineral ingredients to the subjacent strata or subsoils, we have, in the first instance, to consider how far the soil may have been washed down slopes over the surfaces of strata with which they can have but a partial relationship, or, perhaps, no relationship at all. We have also to consider that soils are everywhere liable to modification, as Mr. Clement Reid has pointed out,* by the adventitious matter showered over the surface by winds. Stiff clay subsoils may also become lightened in this way, by the incorporation of wind-borne sand or soil which enters their fissured surfaces in dry weather; and even pebbles from a thin gravelly soil are introduced through cracks in stiff clays three or four feet below ground.

The geologist is well prepared for these phenomena, as he is also prepared for the occurrence of strange pebbles and pieces of rock which in the course of manuring have been added to the surface of the land.

The depth of soil is no doubt greatly influenced by the nature of the subsoil. In Norfolk there are no very hard rocks, and except on the chalk and on the stiffer clays there is seldom any well-marked plane of separation between soil and subsoil. Elsewhere the mixed subsoils which characterize much of the county are readily weathered and broken up, and deep indigenous soils naturally occur in favourable situations.

The soils of Norfolk have formed the theme of several essays. William Marshall, who in 1787 published two volumes on 'The Rural Economy of Norfolk,' was for two years agent to Sir Harbord Harbord at Gunton. Curiously enough, he remarked that "A singular uniformity of soil prevails throughout this county; there is not, perhaps, an acre in it which does not come under the idea of a SANDY LOAM. Its quality, however, varies

* Geol. Mag., 1884, p. 165.

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widely, both as to texture and productiveness."* Among those who early recognized the importance of geological maps was the old Board of Agriculture. In 1796 they issued a "General View of the Agriculture of the County of Norfolk," by Nathaniel Kent of Fulham. He dealt very briefly with the "Surface and Soil," but recognized that "The prime parts of the county lie north and north-east of Norwich," that to the south and south-east the land is "fruitful though to a less degree than the former," while the western part of the county "runs, in general, light, and its best dependence is upon the fold."

In 1804 a second "General View of the Agriculture of the County of Norfolk," intended as a supplement to the work of Kent, was prepared and issued by Arthur Young, then Secretary to the Board. The section on soils was much enlarged, and accompanied by a map giving the main divisions, as follows: light sand, good sand, marshland clay, various loams, rich loam, and peat. The grouping adopted by Young showed that he had a good grasp of the subject, for he had "travelled many miles, in order to give it as much accuracy as such a sketch admits, short of an attention that would demand years rather than months perfectly to ascertain."

In 1844 Richard Noverre Bacon published "The Report on the Agriculture of Norfolk, to which the prize was awarded by the Royal Agricultural Society of England." He noted the leading soils in different areas, but made no attempt at any general classification, finding exceptions in every district. Thus, for example, of the soils near Foulsham, he observes (p. 21), "Some of a light gravelly nature, some strong, and some fine kind loam, and friable; some, cold clayey loam, but productive if stimulated by plenty of manure; the subsoil being brickearth, gravel, and sand, with a tender calcareous clay and marl."

Three years later the Royal Agricultural Society published the important essay, "On the Geology of Norfolk as illustrating the laws of the distribution of Soils," by Joshua Trimmer. No one since the time of William Smith had been so well qualified to carry out the task which he set himself of determining: "The laws which regulate the distribution of soils under the combined influence of the solid strata and the drift."

* Vol. i. p. 11.

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Fortified with a sound general knowledge of his subject, he commenced work at Norwich, where, as he says, "I found the variations of soil so sudden, so frequent, and apparently so arbitrary, that I almost despaired of reducing them to any law." He, therefore, appealed to the cliffs of Cromer, which might not now be regarded as the best preparation for definite classification, and thence strove to carry out his "purpose of laying down the variations of soil upon the Ordnance map." He tells how in little more than a week he gained confidence and formed a theory; but as he advanced into South Norfolk he was at fault. "Clay occurred where I expected to find sand, and sand where I looked for clay." Then he "repaired to the coast sections at Gorleston, and the river sections of the valley of the Waveney, and found that these apparent exceptions were likewise a consequence of the law, and proved its truth." Having thus examined the eastern half of the county he "passed more rapidly over the remainder, making wide traverses, and ceasing to map the surface variations."

Although I am not aware that any of Trimmer's maps have been preserved, there can be no doubt that his main work was to map the subsoils, meaning thereby the solid strata and the drift as they appear at the surface. As he remarked, the scale of the (one-inch) Ordnance map is the smallest on which these variations can be shown, and he illustrated them by means of sections.

In a later paper, published in 1850, Trimmer made "Proposals for a Geological Survey specially directed to Agricultural Objects." In this work he adopted a classification into Local, Alluvial, and Diluvial or Erratic soils. The *Local* soils were "those derived wholly from the decomposed materials of the subjacent stratum, represented in ordinary geological maps as constituting the surface." The *Alluvial* soils were those belonging to river and estuarine deposits, including peat bogs and blown sands; while the *Erratic* soils were those derived from the Drifts. Such a classification is not in accordance with our present ideas, inasmuch as the three divisions are equally to be regarded as *local;* the alluvium bordering our rivers, and the various drift deposits yield their local soils just as much as the more regularly disposed solid strata. The exceptions, as before mentioned, are the materials washed down slopes and those which are wind-drifted.

Trimmer did excellent work in calling attention to the importance of a systematic survey of all the superficial deposits

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which in old days had been contemptuously spoken of as "extraneous rubbish," and which had been sadly neglected by the Geological Survey. His work was carried on with equal vigour and enthusiasm in subsequent years by Searles V. Wood, junior, who in 1865 had made a general survey of the Drifts in more than eight English counties, and a complete survey of Essex on the one-inch Ordnance Map.

The Geological Survey had commenced its labours in the south-west of England in a region comparatively free from superficial deposits, and as their operations were extended towards the Midland Counties they found the solid geology to be so masked in places by Drift, that "Boundary wholly conjectural" or "Boundary everywhere deeply hidden below drift" was inserted on maps published as late as 1865. This method called forth strong language from Wood, and no wonder when we know that the Drifts are sometimes from 100 to 250 feet thick. In such districts they have more influence on the land than the so-called solid formations, and are then of far greater importance in reference to agriculture, local water supply, and sanitary questions. This is now fully recognized; but at the same time it must not be forgotten that in all these questions the solid formations, where they come to the surface, are of equal importance with the drifts.

That the subsoils of Norfolk cannot be rapidly surveyed was the opinion of the older agriculturists, and we find that Wood's first sketch survey was modified by the later detailed work which happily he induced Mr. F. W. Harmer to undertake.* It is, perhaps, not surprising that the results of this work showed that Trimmer had failed to grasp the true sequence of the Drifts, as he had grouped together the Cromer Till and the Upper or Chalky Boulder Clay as Lower Drift, and had placed the Contorted Drift and the mass of Glacial Sands and gravels as Upper Drift; a difference of great importance in the elucidation of the structure of the county.

In this connection I may mention that the Geological Survey commenced its labours in Norfolk in 1875, and closed them in 1884, after a period of nine years, when no less than ten officers

* A reduced copy of the geological map by Messrs Wood and Harmer was published by the Palæontographical Society in 1872. See Supplement to S. V. Wood's Crag Mollusca.

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had been engaged for longer or shorter periods—on an average four years each, equal to the work of one man for about forty years, or at the rate of about fifty square miles a year. The results of this work are shown on the one-inch Geological Survey Map.* Summarized, the general grouping of the subsoils is as follows:—

	Formations or Subsoils.	Chief Characters.
Recent.	Alluvium	Clay, silt, and peat.
	Blown Sand	Loose sand.
Pleistocene, including Glacial.	Valley Gravel and Brickearth	Gravel, loam.
	Upper or Chalky Boulder Clay	Chalky clay with stones and boulders.
	Glacial Sand and Gravel † ...	Sand and gravel.
	Contorted Drift	Stony loam and marl.
	Lower Boulder Clay (Cromer Till)	(*Only exposed in cliffs*).
Pliocene.	Cromer Forest Bed Series ...	(*Only exposed in cliffs*).
	Norwich Crag Series ...	Pebbly gravel and sand with shells and seams of clay.
Cretaceous.	Chalk	White limestone with flints in upper part.
	Gault and Red Chalk ...	Marly clay, red limestone.
	Lower Greensand	Sand and sandstone, with band of clay.
Jurassic.	Kimeridge Clay	Clay and shale.

That these formations have influenced the soils and agriculture of the county was clearly recognized by the old agricultural writers before the sequence of the strata was understood and made known. A brief account of this influence may now be given, dealing with the strata according to their leading lithological characters.

The *Chalk* comes to the surface over considerable tracts in West Norfolk, from Hunstanton to Swaffham, and Thetford; it also appears in places on the slopes of the Bure, Wensum, and Yare valleys. Less, perhaps, than any other formation in Norfolk has it contributed to the soil. The entire area having being overspread with Drift, we find patches of it here and there along the chalk

* A reduction on a scale of an inch to four miles has been published in the 'Victoria History of the Counties of England,' Norfolk, vol. i.

† In part newer than the Chalky Boulder Clay, and in part associated with the Contorted Drift.

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outcrop in West Norfolk, while elsewhere the relics of Drift, left after the erosion of the land, form the main ingredients in the thin loamy and sandy soils which prevail, although these have been added to by wind-drifted material, and by the clayey residue which results from the dissolution of the chalk.

Young, in his "Light Sand," included the country about Harling and Thetford where there is much loose and blowing sand; a district on the borders of Suffolk, referred to by Trimmer as the "District of the thin Upper Drift," of which it is said "that a gentleman, being asked in which county his property was situated, replied, 'Sometimes in the one, sometimes in the other; it blows backwards and forwards.'"* Here the geological map can do no more than indicate "sandy soil" or "loamy soil" on the chalk tracts. On the borders of the river valleys the chalk is naturally masked to a certain extent by downwash.

Marls belonging to the *Contorted Drift*, but consisting of rearranged or ground-up chalk, occur in the neighbourhood of Gunton, and westwards to Roughton, Edgefield, and Weybourne, and they become more or less incorporated with the Chalky Boulder Clay further west towards Walsingham and Fakenham.

The *Chalky Boulder Clay* often partakes of the nature of a marl; it is largely a tough bluish-grey clay full of chalk stones, flints, and many fragments of all kinds of rocks, but with occasional seams and beds of sand and chalky gravel. Analyses of its soils should show a great variety of constituents. It weathers into a brown stony loam, and usually yields a soil of this character, a soil referred to by Trimmer as the "Warp of the Drift," but the term was applied by him also to rainwash of similar material derived from different subsoils. The Boulder Clay covers extensive tracts, more especially in central and south-eastern Norfolk, where it forms the heavier lands of the county whereon wheat and beans flourish, as in the area which extends from Fakenham and Foulsham to Dereham, Hingham, Wymondham, Long Stratton, Tivetshall, Diss, Harleston, and near Loddon. The land is fairly flat with well-timbered hedgerows, with many village greens and commons, and broad strips of grassland alongside the roads and lanes. Much of the country has thus a park-like aspect.

Around Burlingham the loamy soil is thicker, and the land in consequence lighter. It is lighter also in West Norfolk, where the

* 'Geology of Norfolk.' Journ. R. Agric. Soc. vol. vii. reprint p. 37.

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Boulder Clay is thinner, and much of it sandy and more chalky. There heaths and warrens are found, for it is a region where the soil is liable to be drifted by strong winds.

Of other clays the *Kimeridge Clay*, which outcrops on the slopes at Southrey, Downham Market, and near Lynn, is naturally a stiff clay, but the soil is ameliorated by downwashes of sand from the scarps of Lower Greensand.

Clay locally occurs in the *Lower Greensand*, as at Snettisham, where it forms a belt of moist springy ground.

The *Gault* is a bluish-grey marly clay with phosphatic ingredients, as at West Dereham, Shouldham, and Gayton.

These clay soils are all more or less lightened by relics or downwashes of sandy material, and they constitute a part of the "Various loams" of Arthur Young, with which he included the Chalky Boulder Clay tracts, and the brickearth of limited extent which occurs in the Nar valley between Narford and West Bilney, also near East Winch and to the north of Middleton.

Brickearth or loam is also met with between Burnham Overy and Holkham.

The principal district of loam, "one of the finest tracts of land that is anywhere to be seen," the "Rich loam" of Arthur Young, occurs in East Norfolk, the region of the *Contorted Drift*. There we have a variable formation, largely a stony loam, but intermixed with sand and gravel, as well as marl, so that lighter lands occur in the midst of more fertile loams, as at Bacton, Happisburgh, and Waxham, at Stalham, Tunstead, Ormesby, Acle, Hamlington, Plumstead, and Catton.

Sands occur in the *Lower Greensand* from Denver to Castle Rising, Sandringham, and Heacham. The soil is variable in quality, the silvery sands at the base, as observed by Mr. G. W. Lamplugh, being sterile in comparison with the upper sands, which are often crimson and purplish in colour, and are locally hardened into the ferruginous sandstone known as carstone. Dry, heathy commons and warrens with tracts of woodland prevail.

The *Norwich Crag Series* yields light sandy and gravelly tracts as at Crostwick, Coltishall, Catfield, and Ludham, with loamy belts at Wroxham, Reedham, and Surlingham.

Large heathy tracts with many fir plantations, rabbit-warrens, and sheep-walks characterize the *Glacial Sands and Gravels*. Thin patches of these deposits occur in the region of sand-storms,

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near Methwold, East and West Harling, and Wretham. They occur also at Gressenhall, Rudham, and Syderstone, and in greater force at Mousehold, Felthorpe, Haveringland, Horsford, Cawston, Aylsham, Holt, Sheringham, Aylmerton, and Felbrigg. Here the soil is sometimes peaty, while the gravel is locally cemented into an iron-pan.

"Good Sand" was noted by Arthur Young in North and North-west Norfolk, where sands and gravels rest on marl or chalk, as near Stiffkey, Wells, the Burnhams, and Docking. The gravels here sometimes contain chalk pebbles.

The Alluvium forms the Fenland, the strips of flat meadow-land which border the rivers, and the marsh-lands which widen out in their lower courses in the region of the Broads. These tracts have a character of their own on account of their physical features. They vary, however, greatly in soil. There are areas of peat and areas of clay and silt, and their fertility depends on their being well drained. For the most part they are protected by embankments, but on the north coast near Wells and Stiffkey there are salt-marshes liable to be flooded by the sea at high tide. Together these tracts constitute the "Marshland Clay and Peat" of Arthur Young.

The results of this review show that while there is a general correspondence between the subsoils and soils, yet there is an infinite variety in the soils such as cannot be fully indicated on a geological map, and can only be inferred from a knowledge of the subsoils. The general groupings of old agriculturists are good, but in detail they are of little use. The fact is that the Glacial Drifts which so largely influence the soils of Norfolk are liable to change laterally as well as vertically in a more abrupt manner than we usually find to be the case with strata in regions where there is little or no Glacial Drift. It is a county of mixed soils, largely owing to the mixed subsoils, but not wholly so.

Elsewhere we have mixed subsoils in such formations as the Reading Beds and the Forest Marble, but yet, as a rule, in the southern counties of England we find that the geological formation which underlies the mantle of soil, however much or little weathered that formation may be, imparts a character to the soil. This is notably the case where the red Keuper Marls come to the surface, and we can discern in ploughed fields on the steeper scarps, through

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the screen of soil, the junction with the grey and green marls which form a passage into the Rhætic Beds. On the gently sloping uplands we can follow the junctions of the White Lias of the Upper Rhætic Beds with the overlying Blue Lower Lias across many an arable tract where fragments of the well-known Landscape Marble and of White and Blue Lias are turned up by the plough. Again in Dorset, the silicious sands of the Upper Green Sand and the calcareous sands of the Lower Oolites impart distinct characters to the soil and vegetation. In those regions of course there are many exceptions where the soil has been shifted down the slopes, but there has not been that overspread of Drift which in the Eastern Counties was afterwards in places largely washed away so that in some areas the remnants exist merely in the soil, and cannot be distinguished on a geological map.

Expert knowledge seems, therefore, needful to interpret maps whereon the superficial extent occupied by the many different geological formations is shown irrespective of the carpet of soil.

The question has often arisen, can maps be made for agricultural purposes to show the distribution of soils. No one, so far as I know, has attempted this in detail. The little maps published in the 'Journal of the Royal Agricultural Society' have been subsoil rather than soil maps. Maps on a scale of at least six inches to a mile would be necessary in order to admit of the variations of soil being indicated in reference to every field, but such a map comes hardly within the reach of practical geology.

The natural divisions of soils are those based on their lithological or mineral character, using the term in a general sense to include gravelly, sandy, loamy, clayey, marly, brashy, and peaty soils. All these shade one into the other, so that we have gravelly clays and stony marls, peaty sands, sandy soils with gravelly patches here and there, and so on.

On this account, as soils merge laterally, it would be far more difficult to draw any boundary-lines on maps to separate them, than it is to draw lines separating the subsoils which, whether in uniform or variable masses, overlie one another.

Trimmer, in his paper of 1850, suggested a notation which has been followed in some of the German agricultural maps. Thus, if f indicates fine sandy loam, g gravel, and s sand, $\frac{f\ 10''}{g\ 2'}$ placed $s\ 4'+$

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on a map would indicate 10 inches of fine sandy loam, over 2 feet of gravel, over 4 feet of sand, full depth not proved.

These German maps are, however, true geological or subsoil maps. They do not show the surface distribution of the soils, beyond what can be gathered from the numerous symbols marking points where trial holes or other observations were made. They are, however, of great value in showing the depth of soil, and also of the subsoils, so far as they would influence drainage and other agricultural operations. Undoubtedly maps of this kind are the most important that have been published, and, moreover, they are accompanied by detailed explanatory memoirs with analyses.

Were a detailed map of the soils prepared, it would not, I believe, be so valuable by itself for appraising the agricultural capabilities of the land as a detailed subsoil map. The soil map would fail to give any idea of the structure of the ground and of the drainage. It would be easier to picture the general character of the soils from the subsoil map than to infer the nature and extent of the subsoils from the soil map. In estimating the capabilities of the land, the pervious or impervious nature of the subsoil is of the utmost importance.

When acquaintance has been made with the character, thickness, and extent of the subsoils, and the way in which they have influenced the soil, with the extent of rainwash and the distribution of the underground water, then I think the geological surveyor may pass a rough and ready examination into the general agricultural characters of the land. He may even convince the farmer who cultivates a few acres that a geological survey may be useful, and that it is wrong to think that "Government be allays a doin' summut queer."

A detailed subsoil map on a scale of 6 inches to a mile, carefully and judiciously surveyed, should serve as a basis for special investigations of soils. On it the general characters of soils should be indicated, and where there is much landslipped material or considerable downwashes of the subsoils these should be marked. Sometimes downwashes of gravel from the uplands are of sufficient importance to have shallow gravel-pits opened in them, or buildings may be erected on them--and yet in ordinary geological maps, which profess to show the Drifts, this debris from higher grounds,

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or "run of the hill," has been omitted when it is of sufficient importance to influence the surface features. This is, undoubtedly, a defect.

Perhaps the greatest difficulty in the making of a geological map is where to discriminate between a thin subsoil and a soil in which is incorporated all that remains of a thin and weathered stratum. The difficulty appears where a shallow patch of gravelly soil appears on a clayey tract, and if an outlier of gravel be mapped, difficulty again arises in defining its limits. Troubles of this kind must ever attend the path of the geological surveyor.

Where, however, indications of the thickness of soils and thin subsoils are given, and the survey has been carefully made on a large scale map, the result should, for all time, be of the greatest service in questions, not only of agriculture, but in reference to sites for buildings, sewage farms and local water supply: subjects in which geology, agriculture, and sanitary science are alike concerned.

XXII.

OBITUARY NOTICES.

THE LATE D. C. BURLINGHAM OF KING'S LYNN.

By Charles B. Plowright, M.D.

On the 1st April, 1901, at his residence, 81 High Street, King's Lynn, died Daniel Catlin Burlingham. Born in 1823, he belonged to a small group of naturalists who, at a time when Natural History was much less popular than it now is, pursued with great pleasure to themselves its study in West Norfolk. A member of the Society of Friends, which at that time formed in Lynn a small but highly intellectual body, of good social position and greatly respected, Mr. Burlingham possessed so marked a personality that he was known practically to all the inhabitants of the district in

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DANIEL CATLIN BURLINGHAM.

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which he resided. With a splendid physique and robust health he was able to undertake and enjoy exertions from which most men would shrink. In the later years of his life, his white hair, his long flowing beard, his refined, intellectual, handsome face never failed to attract the attention of strangers. Ready to chat with any one, he literally lost no opportunity of acquiring information nor of imparting it. To rich or poor, old or young, he was equally accessible. Few men possessed more winning manners, or greater powers of gleaning information, or of extracting enjoyment from the observation of facts and phenomena, by himself and others, than he did. There was scarcely a subject with which he was not to some extent familiar and upon which he could not converse; but like so many of the practical naturalists of the early part of the last century, he always shrank from recording his observations, and as a correspondent it was all but impossible to elicit a reply.

In the present instance it is with him as a naturalist that we are more particularly concerned, and it may fairly be said that his interest in Natural History was all round. In early life, Botany—in middle life, Ornithology—and in his later years, Astronomy—were his special studies; but in Geology, Meteorology, and Topography, he was scarcely less interested.

A native of King's Lynn, he carried on the business of his father,—watch-making, to which that of a jeweller was subsequently added. His speciality, however, was in the repair of chronometers and other instruments of navigation, a work which he personally carried out. When quite a young man, he devoted much time to botany. His herbarium, which still is in the possession of his family, was commenced about the year 1839, apparently in conjunction with his sister, Miss Lucy Burlingham, who died early in life. In field-botany he was associated with Mr. William B. Pung of North Wootton, who likewise was an ardent collector of Norfolk plants. The herbarium contains specimens of plants from many other parts of England, especially from the neighbourhood of Epping, where his cousin, Mr. Henry Doubleday, resided, with whom he carried on an active correspondence. Amongst the contributors to this herbarium was Dr. Robert Kaye Greville, F.R.S., the author of the 'Scottish Cryptogamic Flora.' Between the years 1839 and 1843 his botanical correspondence was evidently very

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considerable, so that his herbarium contains representatives of most British Phanerogams as well as of Ferns.

The study of ornithology possessed, to him, entrancing and life-long interest. He was familiar, not only with the birds of his own district, but with those of other parts of England. He visited many—then comparatively unknown—parts of Scotland in search of birds and their nests.

As early as 1844 he went to the Western Highlands, and possibly visited Skye; but four years later he made a prolonged visit to the Hebrides.

Leaving Lynn by the steam-packet for Hull, he there took another steamer to Newcastle, and thence one to Grangemouth. From Edinburgh to Glasgow he travelled by train, and so reached Greenock, where he again took his passage on board a steam-boat to Broadford in Skye. He visited the romantic Loch Coruisk. Crossing the island he spent a night at Sligachan, and so on to Portree, where he caught the "Mary Jane" to Stornoway.

From a memorandum book which he took with him, we learn that the whole distance was accomplished at an expenditure of twenty-four shillings and tenpence! Once in the Island of Harris he was on the ground it had so long been his wish to visit.

From Stornoway, Callernash, Tualval and Loch Erisort were visited; he then made his way southward through Achlin to Tarbert and Obbe, collecting eggs and observing the features of the country and its productions. Here he saw the inhabitants not only spinning and weaving, but was much impressed by watching the process of felting or wanking done by a number of women beating in unison the newly woven cloth with their hands, to render it more compact, at the same time chanting a plaintive Gaelic song. He ferried over the Sound into Uist, where he made Loch Maddy his centre.

To show how closely everything was observed by him, the following verbatim extract from his note book is given:—

"1st day:—(Sunday) Went to the head of the Loch (Loch Maddy) over sand, 2 miles—Ring Doterell numerous—Saw several Eider ducks—Small flock of birds I suppose they were Stints, could not tell. Plants:—Sea-kale, *Viola lutea*, *Glaux maritima*, *Arenaria peploides*, Scurvy grass. Rats but no rabbits on the sand hills. Sand composed of small white particles of granite. A man told me there were 16 parts of lime in it. Hard crust in

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places as thick as the hand. A burial-ground in the sand, with a square tomb, no roof, no inscriptions.

"2nd day (Monday) along the coast towards Vallay. Did not call on Mac R., ascended the highest hill in the west of the Island, a long slant of peat 3 or 4 feet thick in parts on the summit. A very extensive wild view West, Hesker, St. Kilda. North-West, most of Harris and Lewis. East, Skye and the Mainland; ragged gorges and clefts in the Cuchullins glistening with snow. South, Benbecula and South West, below me, innumerable Lochs. Went to one supposed to be Scadaway. West end, saw two geese with 5 young: 2 geese with 2 young: 4 other geese flew into the Loch. Lesser and greater Black-backed Gulls. In a small piece of water in a mossy swamp saw two Red-throated Divers, which after repeated diving took flight —no eggs—Found nest of the bird supposed to be the Purple Sand Piper,— heard its peculiar note—no eggs in it. Saw Richardson's Squa, think they had not laid. Loch M—— round the side going to Loch Maddy, saw one Red-throat—Hunted one side of the Loch—no success."

In the following extract from a letter to his sister, dated Tighary Inn, 6 mo., 17, 48, he again aptly describes the above scene, almost in the words of Harvie-Brown and Buckley,* who speak of the extraordinary mixture of land and water presented to the eye in North Uist.

"Embracing a most extensive area. A long stretch of mainland the Isle of Skye, Lewes, South Uist St. Kilda. Patches of snow on the Cuchullins [in Skye] shone with a dazzling whiteness and below the hill the country seemed one immense sludgy pool dotted with Islands. You would think it impossible for any road to thread its way amongst them."

After visiting Tighary, Loch Nan-Ian, Loch Scatavagh, and other places, he turned northwards again to Obbe, Tarbert, Balallan, Loch Erisort, and Stornoway. During this excursion he evidently lived upon the simplest fare, consisting mainly of milk, eggs, oat cake, cheese, etc. The largest single entry in his pocket book is £1 for birds' eggs. On one occasion he swam to a small island in one of the Lochs to obtain specimens of some gulls' eggs, and having no other appliance convenient for their transport, he carried them back in one of his boots, which he held between his teeth as he swam. On another occasion his beaver hat was used in like manner for the same purpose.

From Stornoway he took the steamer to Loch Alsh, from which place he tramped to Clunie and Tomdown, thence along Loch Garry to Invergarry, from which place he took the steamer to Banavie.

* 'Vertebrate Fauna of the Outer Hebrides,' 1888, p. lxi. and plate.

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Writing to his sister again, he describes the discovery of the Snow Bunting, in all probability breeding on one of the mountains of Glen Garry, which is probably one of the first recognitions of this species now known to nest on several of the Scotch mountains.

In a letter to his sister, dated Tomdown, Loch Garry, Invernesshire, July 5th, 1848, 5th day, he writes:—

"Some of the scenery is very mountainous and romantic. Many of the hills have still deep patches of snow in hollows on their northern sides near the summits. I made the ascent of one yesterday with much snow upon it. Thou mayst fancy my delight in approaching the cairn to see a bird on its very apex whistling away with notes sharp and clear, strange to me and which proved to be the Snow Bunting supposed to be confined to much more northern latitudes. It seemed like a little fairy sprite as it sprang into the air whistling on the wing and then down again, the snow-white breast, head, parts of the wing and outer tail feathers contrasting beautifully with the jet black back and ends of the wings——"

It was during these wanderings in the remote and at that time unfrequented parts of Scotland that he found the Highland plaid so useful, a garment which he ever afterwards used; he did not ever possess an overcoat up to the time of his death. His Argyle-plaid was on one occasion stolen by a professional thief who visited Lynn. On this man's arrest in another town for some other misdemeanour the plaid was found in his possession, and at his special request returned to "Mr. Burlingham of Lynn."

Nearer home:—Whittlesea Mere was, in his early time, a great place for wild fowl. He visited it on several occasions, once with his ornithological friend, Mr. John Pung, in search of the Water-rails' eggs which were to be found there then in great numbers. On that occasion they both returned with their clothes almost cut to pieces by the sharp blades of the *Cladium mariscus* which grew so abundantly there. He also visited Whittlesea Mere with his friend Edward L. King, who was not only an ornithologist but an entomologist, and whose special object was to obtain the Swallow-tailed butterfly then so plentiful in that locality.

An excursion to Wicken Fen with Mr. Thomas Southwell in search of Savi's Warbler lives still in the remembrance of those of us who have heard the account of it from our Ex-President himself.* A bird or a fen never failed to attract him, and they

* Although not successful on this particular occasion, the nest of this bird was subsequently obtained from Feltwell Fen by Rev. W. M. Allen.

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were often associated to his mind:—Wicken with Savi's Warbler, Roydon with the Hen-Harrier and Short-eared Owl, and Shouldham with the Grasshopper Warbler, and so on.

A subject which greatly interested him was the topography of the Fens.

As he was an ardent lover of skating he was able to trace out the various systems of fen drainage upon the ice. Having a branch business at Peterborough he more than once, the ice favouring, made the journey on skates. On another occasion he skated from the Nene to the Trent with two of his sons. An account of which excursion from his pen will be found in 'Fen Skating,'* p. 179.

The bursting of the Middle Level Sluice on the 6th May, 1872, when 20,000 acres of land were flooded by sea-water, constituted one of the events of the century in the history of Fen-land. He visited the locality several times during the flood, and thus describes his visit to the breach in the bank in a row-boat:—

"Passing on we became sensible of our near approach to the great breach by the current within, and the flood water without the bank, approaching to the same level. Arrived at last at the end, we beheld a scene calculated to make a life-long impression. It was a gushing out of the water. A rushing, boiling, eddying stream, which was filling the Fen country with fearful rapidity. Already, almost as far as the eye could reach, the land was submerged; only here and there a house, a stack, a shed, and old thorn bush with snowy head or a field of tall rape with its yellow blossom, appeared above the water."

The great pleasure with which he watched Donati's Comet in the summer and autumn of 1858, evening by evening, remains vividly impressed upon my mind. This comet was visible to the naked eye for 112 days, from June to October. At its brightest, its tail formed an arc of 40°, and during the last named month it passed between the earth and Arcturus, a phenomenon which impressed all observers. The Leonid Shower (Nov. 13-14, 1866) he observed, wrapped in his favourite plaid, as he kept an all-night vigil on Lynn Market Place, to the great astonishment of the night police-men.

By nature sanguine in temperament he took life very earnestly, his pleasures were real, so were his pains. He retained the full use of his intellectual faculties to the last. The tragic death of his son Alfred, a young man of great promise, who was killed by an

* 'Fen Skating.' N. & A. Goodman, London 1882. 8vo., with map and numerous illustrations.

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explosion of acetylene gas in December, 1898, was a great blow to him.

A firm believer in peace, he strongly opposed the resort to war under any conditions. It is not too much to say that the last months of his life were saddened by the recent war in South Africa, which he considered as not only being wrong, but in the highest degree detrimental to the best interests and good name of England. Nor did he lack the courage of his opinions in denouncing it. It is significant, as an indication of the general respect in which he was held, that when other opponents of the war had their windows broken by the rabble, his escaped.

Mr. Southwell has, at my request, furnished me with the following early recollections of our mutual friend :—

It is so many years since we practically lost sight of each other, and Burlingham was such an impossible correspondent, that I shall have little to say of present interest.

It was in the year 1846 that I left school and entered upon the struggle for existence—at that time the merchant aristocracy of Lynn was fast yielding before the introduction of steam navigation and railroads, and giving place to the more modern methods with which they could not conform, and I fear a similar decadence was taking place in the intellectual standard of the society of the town—there were signs of a similar change which took place in the first half of the century in the City of Norwich—but one legacy which they left behind was an excellent Subscription Library, containing many valuable books not often found in a provincial town, and which spoke well for the literary taste of those who had made the selection; there was also a society which flourished under the somewhat pretentious title of the "Lynn Conversazione and Society of Arts," embodying amongst its members men who fairly represented most branches of science, including archæology, mechanics, and chemistry. It was at the meetings of this Society that I first made the acquaintance of three friends, Daniel Catlin Burlingham, Edward Laird King, and Thomas Pung. I had from my earliest years been an ardent lover of birds, and here were three men all somewhat older than myself who gave me the benefit of their experience; all were botanists, and all more or less interested in ornithology, two were skilled mechanicians, and well versed in the sciences of horology and optics, and King and Pung were microscopists, all possessed of libraries of works bearing upon their favourite studies. But it was Burlingham's love of out-door pursuits that cemented our friendship, and many were the tramps over heath and fen that we made together. He seemed to be made of untiring material, and no amount of walking came amiss to him. After attending the Quarterly Meeting of the Friends at Norwich or Wells I have known him to walk back to Lynn, from the latter place by the coast, studying the birds and plants by the way, and wading or

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swimming the creeks which had to be passed. He was a very strong swimmer—an art which he took care to impart to his children—and seemed as untiring in the water as upon the land, and equally regardless of temperature. Many a time have we walked miles together in the dark to listen to the cries of the night-birds in the woods or on the heaths, and he would go out with me with my gun in the early morning, but only to spoil sport, for he was fonder of watching the shore-birds than slaying them, and although he was ever ready to measure, describe, and dissect our victims, such was his gentle nature that I never knew him knowingly to cause the death of bird or beast.

Burlingham loved to strike a bee-line across country, through enclosed lands, woods, heaths, and bogs, fording streams where possible, and running the gauntlet of gamekeepers, with whom he rarely came in contact. One such ramble, which took place in, I think, the year 1852, I attempted to describe in Morris's 'Naturalist,' vol. v., p. 27, but I can recall many such.

The trips to the Western Highlands and to the Hebrides were bright memories. In the former journey, in 1844, he found the Wigeon breeding in Glen Garry (Inverness), and in 1855 I found three nests of that bird in the same locality from information which he gave me. His visits to Feltwell Fen (Popilot) and Wicken were not profitable in their main object, which was to search for Savi's Warbler, but they were delightful outings, and although I never remember to have heard him say so, it is quite possible that at Whittlesea Mere, which he visited at least twice, he may have seen the Great Copper Butterfly, for as late as 1836 Salmon says in his diary that their larvæ were so common as to be sold for 3d. per dozen, adding, that a man named Philips told him "a few years ago" he had collected 30 dozen for one person. He, however, found the eggs of the Water Rail. Roydon Fen, a few miles from Lynn, was one of our favourite hunting grounds, and here he found the eggs of the Spotted Crake, and in the same place I found those of Montagu's Harrier. The Short-eared Owl we saw there several times, but never discovered a nest. This wet fen was, in summer, a perfect paradise, and amongst the botanical rarities were the Cranberry and *Pyrola rotundifolia* with many other beautiful bog plants.

I could gossip to any extent about those early days when Burlingham and myself were much together, but I am afraid it would necessitate my being too personal, and I can only add my tribute of admiration for a man without guile, a true friend, and a delightful companion, whose eccentricities were many, but all amiable.

Archdeacon William Pelham-Burn.—The Venerable Archdeacon W. Pelham Burn, who met with his death very suddenly in the Tyrolese Alps early in September, had been resident in Norwich since 1890, when he was elected to the important living of St. Peter Mancroft. During that time he had taken an active part in the public affairs of the city, particularly as a member of

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the School Board and Chairman of the Board of Guardians, as well as interesting himself in the management of many of the City Charities. He was at no time an active member of our Society, nor did he make any branch of natural science his particularly study, but he much enjoyed country walks, especially among the mountains; and being a keen photographer he delighted to bring home records thus obtained of places he had visited and scenes that had pleased.

In August died Mr. John Young, F.Z.S., who was the second son of the late Rev. E. N. Young of Quainton, and was for many years in the War Office. An ardent ornithologist, he made the habits and migrations of birds his special study; in pursuit of this he took excursions, during his annual leave, to Holland, Hungary, and the mouth of the Danube. It was he who first discovered the eggs of the Snow Bunting in Great Britain. In years past we have been indebted to Mr. Young for several contributions to our 'Transactions,' one of especial interest being "Observations on the habits of the Bearded Tit in confinement."

Mr. Edward Lewis Birkbeck, who died in October at the early age of 41, entered the bank of Gurney & Co., in which he became a partner in 1879. He was very popular, both as a man of business and a keen sportsman, and though he had not devoted much time to the study of Natural History, he was a close observer of Nature, and the note-books of our ornithologists were enriched by records of what he had seen when watching rare visitants to our county.

We were glad to have numbered amongst our members the Rev. Hugh Alexander Macpherson, although he had ceased to be a member shortly before his death. His latest book, 'The History of Fowling,' was published in 1897, but the 'Fauna of Lakeland,' his most important work, preceded it several years, at which time he was resident in Carlisle. It has been truly said of him that he was "equally eminent both in field and cabinet work, while as a scholar he wielded a pen of high literary excellence." Mr. Macpherson contributed to our 'Transactions,' with other papers, two of great value on "The habits and plumage of the Manx Shearwater."

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XXIII.

MISCELLANEOUS NOTES AND OBSERVATIONS.

"Post Glacial" Faults on the East Coast.—In a short paper Mr. Longe brought before the notice of the Society certain dislocations or faults in the strata exposed in the cliffs of the East Coast, which he regarded as effects produced by lateral pressure after the deposition of the Chalky Boulder Clay. He used the term "faults" in its most comprehensive sense, and the term "post glacial" in accordance with the general usage of geologists—without implying his adoption of the glacialists' theory that the Chalky Boulder Clay of East Anglia is in any way a glacial production.

He noticed first the effects of lateral pressure exhibited at Lowestoft—and referred to a pamphlet entitled, "Did the Waveney ever reach the Sea *via* Lowestoft?" written some years ago by Mr. Edwards, the engineer of the harbour works undertaken in 1821.

In cutting through the narrow isthmus which separated Lake Lothing from the sea, Mr. Edwards met with a mass of Chalky Boulder Clay some way below the surface, and under this a bed of sand of the depth of thirty feet, which he identified as the same deposit of sand as that comprised in the cliffs on either side of the valley, and in some pits inland, known by geologists as the "Middle Glacial."

The position of this bed of sand below the sea level, could only be explained by its having been dropped down by a sort of "trough fault"—during the process of elevation by which these parts were raised to their present height after their submergence in Pleistocene times. Evidence of coast disturbance in the immediate neighbourhood of the harbour was furnished by the discovery of a large mass of chalky loam intruded into the sands of the cliff, about half-a-mile to the south (nearly opposite the present Empire Hotel).

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This intruded material extended from the top to the bottom of the cliff, and was more or less mixed up with the ordinary cliff sands for about fifty yards. From its containing the curious clay concretions, known by workmen as "dodmans," so common in the Boulder Clay of the neighbouring brick-yards, it was evident that this Chalky Loam must be a remanié of Chalky Boulder Clay washed into a fissure or gape in the underlying strata in what are called "Post Glacial" times, that is to say, after the deposition of the Boulder Clay.

He referred to the bendings and undulations of the strata along this part of the coast section, which he considered to be as much evidence of lateral pressure as the more pronounced bendings and distortions of strata seen in other parts, as for instance, in the chalk cliffs on the South Coast.

He noticed also an instance of disturbance in the surface strata, at a spot known as the League Hole, at the southern extremity of the Corton Cliffs, where masses of Chalky Boulder Clay, and "Post Glacial" Drifts are intruded into the older and underlying deposit of "Middle Glacial Sands." This phenomenon is noticed by Mr. J. H. Blake, the Geological Surveyor, in his memoir of the country round Lowestoft.* Another still more striking instance of crust disturbance—in "Post Glacial" times occurs in the North Cliff at Southwold.

This puzzling section is noticed by Mr. Horace Woodward in a paper published in the 'Geological Magazine' for August, 1896. The dislocations of the surface strata, shown by these phenomena, could not take place without the disturbance of the underlying beds. In East Anglia the great chalk formation underlies the more recent superficial deposits, and there is abundant evidence in the undulations of the chalk, as well as in the fractures and dislocations which are to be seen in chalk pits and other exposures, of the effects of lateral pressure. There are good grounds for attributing some, at least, of the disturbances in the chalk, as well as those appearing in the overlying beds, of which those noticed in this paper are examples, to the great crust movement, which, commencing in Pleistocene times, first submerged this area, and then by a movement or movements continued during thousands

* p. 51. See also Horizontal Section Sheet, 128, published by the Geological Survey.

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or tens of thousands of years, raised the same area, or part of it, above the sea, and gave to the British Isles their present surface contour.

Some geologists have attributed the disturbances exhibited in East Anglia in beds, whether of chalk or other deposits, lying on or near the surface, to the action of ice.

See as to this—H. B. Woodward—'Memoirs of the Geological Survey of the Country around Norwich,' p. 134,—in the disturbances in the chalk at Trowse.

See also a paper—by S. Wood and F. W. Harmer—in the 'Journal of the Geological Society,' vol. xxxiii. p. 84, on "Glaciated Chalk in the Valley of the Yare, near Norwich."

He did not question the existence in former times of glaciers in the mountains of Scotland and Wales, with the evidence of which still remaining in the Vale of Llanberis he was himself well acquainted, but he was altogether opposed to the notion that glaciers or ice-sheets ever travelled over East Anglia after it was raised from sea. That icebergs melted over this area, when it was beneath the sea, is evidenced by the numbers of erratics scattered about the present surface. Such phenomena would not necessarily imply a colder climate in this part than that of the present day.

Insects from Narborough and Walton Common on August 5, 1901.—They included—*Pamphila comma*, a butterfly previously recorded from Norfolk on the strength of one specimen only, and *Pamphila thaumas*, a local but much more common species. Several moths were shown, the best species being *Acidalia rubricata*, which occurred flying in the dryest possible situations, and *Nonagria typhæ*, bred from pupæ found in the stems of Bulrushes. The exhibit also included several scarce species of Beetles and Bugs, such as *Anthocomus sanguinolentus*, which is ordinarily found in fens only; *Calyptonotus lynceus*, *Coranus subapterus*, and *Nabis boops*, which last has a special interest as the first British specimens were captured on Mousehold Heath. Some specimens of the Colorado Beetle (*Chrysomela decemlineata*) were also shown. This species has attracted considerable attention of late, on account of the discovery of a flourishing colony at Tilbury during the present summer. An allied species (*Lema*

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trilineata), which is also sometimes destructive to the Potato crop in America, was exhibited.

Specimens of *Anobium paniceum*, the so-called "Weevil" of the sailors, which has occurred in large numbers in a sample of oatmeal were shown by Mr. Bidwell. Scientifically it is not a Weevil at all, but is very closely related to the wood-feeding beetles, known as "death-watches." It is extremely destructive to any dried produce, animal or vegetable. Although so plentiful under certain conditions, it is not often seen, and is only included in the Norfolk list on the strength of an old record.

At a recent meeting of this Society I exhibited a number of insects captured on the occasion of a visit paid to Narborough last August Bank Holiday, and among them was a bug, which I called *Bathysolen nubilus*. I mentioned that it was already included in our Norfolk list, but was one of the rarest of the British species, the only other recorded locality being the Deal sand-hills. Subsequent investigation raised a doubt in my mind as to the correctness of my determination, and I therefore sent the insect to Mr. Edward Saunders, who informs me that it is *Pseudophlœus Waltlii*, a well-known Continental species, but not recorded for Britain.

Bathysolen nubilus previously stood in our Norfolk list on the strength of two specimens, one taken by Mr. F. Norgate at Sparham, and one by Mr. J. Edwards on Unthank Road, Norwich, both of which are in the collection of the latter. It struck me that possibly a mistake had been made with these also, and I therefore wrote to Mr. Edwards on the subject. He has examined his insects and informs me that without doubt they are both *Pseudophlœus Waltlii*. *Bathysolen nubilus* must, therefore, be removed from our list. Evidently it has never been captured in this country, except at Deal, where it was always rare, and is now probably extinct; the Deal sand-hills, one of the most interesting collecting grounds in the country, having been utterly ruined, during the last few years, by golf.

I have also another bug to record, but, under the circumstances of its capture, I think there is no doubt that its occurrence in this country was accidental. It was sent me last November by Mr. A. Mason of Brundall, with the information that it was captured in his dining-room, near a plate of bananas. This also

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I sent to Mr. Saunders, who thinks it is *Strachia picta*, and that it was probably introduced from the Canaries in a bunch of bananas. I may mention it was alive and quite active when it came into my possession. We have a red and black species of *Strachia* with similar markings, but it is much smaller than *S. picta*. It is very rare, and I have never met with it.—H. J. THOULESS.

THERAPHA HYOSCYAMI.—I took an example of this fine bug on College Road, Norwich, on October 30th. It is already in the Norfolk list on the authority of Paget. Its occurrence here is very interesting, as, like many of its allies, it is a southern form, and has not been taken nearer Norfolk than Devonshire and the Isle of Wight.—H. J. THOULESS.

GREAT FLIGHTS OF WOOD-PIGEONS.—The flights of Wood-Pigeons in December exceeded anything I ever saw in Norfolk. At Taverham, Mr. Penn shot 129 in about three hours, on 30th December, and at Weston and Witchingham bags of about 90 were made; on the other hand, in the large woods near Cromer I am told there were very few. All I saw were going north-west.—J. H. GURNEY.

SUFFOLK MOSSES.—As I find there is a mistake in my last year's list I desire to correct it.

Webera elongata, Dicks., p. 235, must be omitted. I had overlooked a letter from the Rev. James Ferguson, in which he says he had come to the conclusion that the specimens are a form of *Bryum pseudo-triquetrum*, Hedw.

Mr. W. E. Nicholson of Lewes has examined Mr. Skepper's herbarium, and tells me that the specimens which were marked by Mr. Ferguson as *Philonotis calcarea*, B. and S., he should call *P. fontana*, L. var. *falcata*. It is, doubtless, the same as the falcate-leaved form sent by Mr. Holmes from Edgefield Heath, Norfolk.—F. N. BLOOMFIELD.

NORFOLK MOSSES.—Mr. Dixon asks me to mention the following corrections to his paper:—

p. 219. *Tortula aloides*, De Not. For "Norfolk specimens in Mr. Skepper's herbarium," read "Norfolk records in O. B. G. under the name of *T. rigida*."

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p. 222. After *Webera carnea*, for "*pendulum*" read "*Bryum pendulum.*"

The footnote on p. 222 was intended to refer to *Bryum turbinatum*, not to *B. pseudo-triquetrum*. The moss so called in 'The Suffolk Flora' is that of Sir William J. Hooker in 'The English Flora,' which includes several species. The specimens so named by Mr. Skepper were *B. bimum*, Schreb., and *B. pallens*, Swartz. The asterisk should be transposed to *B. turbinatum*.—E. N. BLOOMFIELD.

NORFOLK HYMENOPTERA.—Mr. Bridgman's lists are so complete that it is seldom that additions can be made to them. I think, therefore, that the following should be recorded in our 'Transactions':—

TENTHREDINIDÆ.

Tenthredo (*Rhogogastera*) *picta*, Klug. A specimen was sent to me by Mr. Bridgman, taken by him on Mousehold Heath, June 1st, 1889.

Mr. Claude Morley met with the following species in June, 1901:

Tenthredo moniliata, Klug. Rockland.

T. atra, L. Eaton and Rockland.

Cephus linearis, Schrank. Surlingham and Rockland.

These are recorded by him in the 'Entomologist,' December, 1901.

ACULEATA.

Messrs. C. J. Wainwright and R. C. Bradley of Birmingham collected *Aculeata* and *Diptera* at West Runton in the summer of 1900, and met with many interesting species, which are recorded in the 'Entomologist,' July, 1901. Among these, the following Aculeates are new to Norfolk:—

Mimesa equestris, F., abundant. The insect recorded under this name by Mr. Bridgman is *M. Shuckardi*, Wesm.

Halictus zonulus, Sm.

Andrena simillima, Sm., one specimen. This may be a variety of *A. nigriceps*, Kirb., amongst which it was taken.

Pompilus niger, F., also occurred; it had only been recorded from sand-hills near Yarmouth by Paget nearly seventy years ago. —E. N. BLOOMFIELD, Guestling Rectory.

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3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.

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The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year ending March, 1903.

Dr.	£	s.	d.
1902.			
To Balance from last year (including Mr. J. H. Gurney's Donation of £10 10s. towards the cost of New Bookcase)	14	12	2
1902—3.			
,, Transferred from Life Membership Fund for moiety of cost of New Book Case	10	10	0
To Subscriptions:—			
2 for 1897—98 ... ... 0 10 0			
2 ,, 1898—99 ... ... 0 10 0			
4 ,, 1899—1900 ... ... 1 0 0			
6 ,, 1900—1 ... ... 1 10 0			
12 ,, 1901—2 ... ... 3 0 0			
172 ,, 1902—3 ... ... 43 0 0			
6 ,, 1903—4 ... ... 1 10 0			
	51	0	0
,, Additional payments	0	15	0
,, Sale of *Transactions*	1	15	7
,, Transferred from Life Membership Fund	20	0	0
	£98	12	9

Cr.	£	s.	d.
1902—3.			
By Holmes and Son, New Bookcase	21	0	0
,, Fletcher and Son, Limited, *Transactions*, 1901—1902	47	19	6
,, Sundry Printing and Postage	1	0	4
,, A. H. Goose, Printing and Postage	2	6	6
,, Postage and Carriage	4	17	8
,, Insurance	0	9	0
,, Year Book of Societies	0	6	0
,, Bookbinding	4	1	3
,, Coe for Lantern at Meeting	1	1	0
,, Dimmock, Framing Medallion	0	9	6
,, Norfolk and Norwich Library	1	1	0
,, Doorkeeper at Museum	1	0	0
,, Assistant Secretary's Salary	5	0	0
,, Subscription returned, paid in error	0	10	0
,, Balance at Messrs. Barclay's Bank	7	11	0
	£98	12	9

LIFE MEMBERSHIP FUND.

	£	s.	d.
1902. To Balance from last year	87	8	2
1902—3. ,, 2 Compositions for Life Membership ...	8	0	0
,, Interest to November 20th, 1902	2	3	2
	£97	11	4

	£	s.	d.
1902—3.			
By Transferred to General Account	30	10	0
,, Balance in Norfolk and Norwich Savings Bank ...	67	1	4
	£97	11	4

Norwich, 31st March, 1903.

Examined with vouchers and found correct,
STEPHEN WM. UTTING, *Auditor.*

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List of the Publications received by the Society as Donations or Exchanges from March, 1902.

BATH Natural History and Antiquarian Field Club, Proceedings of. Vol. x. no. 1. Bath, 1902. *From the Club.*

BELFAST Naturalists' Field Club. Annual Report. Belfast, 1901. *From the Club.*

BIRDS, A Dictionary of, by Alfred Newton and Hans Gatlow. London, 1893—96. *From Mr. J. H. Gurney, F.Z.S.*

BRISTOL Naturalists' Society, Proceedings of the. Bristol, 1902. *From the Society.*

BRITISH Association for the Advancement of Science, Report of. Belfast, 1902. *From the British Association.*

BRITISH Birds. G. P. Moore, F.L.S. London, 1879. *From Mr. J. H. Gurney, F.Z.S.*

BUCKLEY, Thomas Edward. In Memoriam, by J. A. Harvie-Brown, F.R.S.E., F.ZS. Reprint from The Annals of Scottish Natural History. *From Mr. J. A. Harvie-Brown.*

CARDIFF Naturalists' Society. Report and Transactions. Vol. xxxiii. Cardiff, 1902. *From the Society.*

CETACEA, Recent Memoirs of the, by Professors Eschricht, Reinhardt, and Lilljeborg. Ray Society. London, 1866. *From Mr. T. Southwell, F.Z.S.*

CHICAGO Academy of Sciences. Bulletin no. iii., Vol. ii. The Gross Anatomy of Limnæa Emarginata, Say, Var. Mighelsi, Binney, by F. C. Baker, June, 1900. *From the Academy.*

——— Paleontology of the Niagaran Limestone in the Chicago Area. The Crinoidea, by Stuart Weller, June, 1900. *From the Academy.*

CONSPECTUS Generum Avium. C. L. Bonaparte. Tom. 1 and 2, 1850, 1857. *From Mr. J. H. Gurney, F.Z.S.*

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CROYDON Natural History and Scientific Society. Proceedings and Transactions. Croydon, 1902. *From the Society.*

EALING Natural Science and Microscopical Society. Report for 1901—02. *From the Society.*

EGGS of British Birds, Catalogue of, by Rev. S. C. Malan, M.A., London, 1878. *From Mr. J. H. Gurney, F.Z.S.*

ESSAI sur la Constitution Morphologique de la Tête de l'Insecte, par Charles Janet. *From the Author.*

ETUDES sur les Fourmis, les Guêpes et les Abeilles, par Charles Janet. *From the Author.*

GENERA Insectorum of Linnæus. J. Barbot. London, 1781. *From Mr. J. H. Gurney, F.Z.S.*

GEOGRAPHICAL Journal, The, including the Proceedings of the Royal Geographical Society. March, 1902—March, 1903. *From Mr. H. G. Barclay, F.R.G.S.*

GEOLOGICAL Society, Quarterly Journal of the. Nos. 227—230. August 12th, 1901—15th May, 1902. *From Col. Feilden, C.B.*

GLASGOW, Transactions of Natural History Society of. Vol. vi. New Series. Part 2. June, 1902. *From the Society.*

HARVARD College, Bulletin of the Museum of Comparative Zoology at. Vols. xxxix., xl., xli. no. 1. *From the Librarian, Cambridge, U.S.A.*

HASTINGS and St. Leonards Natural History Society. Ninth Annual Report, 1902. *From the Society.*

HOOKER, Sir William Jackson. A Sketch of the Life and Labours of, by Sir J. D. Hooker, K.C.S.I., F.R.S. *From the Author.*

IBIS (The) a Quarterly Journal of Ornithology. Edited by P. L. Sclater, D.Sc., F.R.S., and A. H. Evans, M.A., F.Z.S. April, 1902—January, 1903. *From Mr. G. F. Buxton.*

LATER Tertiary History of East Anglia, A Sketch of the, by F. W. Harmer, F.G.S. Reprinted from Proceedings of the Geologists' Association. *From the Author.*

LEPIDOPTERA of the British Islands. Vol. viii., Heterocera. Geometrina. Charles G. Barrett, F.E.S. London, 1902. *From the Author.*

LEWIN (W., F.L.S.) The Birds of Great Britain, systematically arranged, accurately engraved, and painted from nature; with descriptions, including the natural history of each bird. [In English and in French.] 8 vols. in 4. 4to. London, 1796—1801. *From Mr. J. H. Gurney, F.Z.S.*

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LEYDEN Museum. Notes from the Royal Zoological Museum of the Netherlands at Leyden. Edited by Prof. H. Schlegel, and continued by Dr. F. A. Jentink. 10 vols. in 5. 8vo. Leyden, 1879—88. *From Mr. J. H. Gurney, F.Z.S.*

LIFE of William Smith, LL.D., by Henry Woodward, LL.D., F.R.S., F.G.S. Reprinted from Proceedings of Bath Natural History and Antiquarian Field Club. *From Dr. Woodward.*

LLOYD Library of Botany, Pharmacy, and Materia Medica, Bulletin of, Reproduction Series, No. 1 and 2, 1900—01. Pharmacy Series, No. 1, 1902. Cincinnati O., U.S.A. Mycological Series, Nos. 1 and 2. Mycological Notes, by G. G. Lloyd. Cincinnati O. Nos. 5—9. *From the Lloyd Library.*

MANCHESTER Geological Society. Parts 10—17, Vol. xxvii. Parts 1, 2, 3, Vol. xxviii. *From the Society.*

——— Literary and Philosophical Society. Memoirs and Proceedings. Part 1, Vol. xlv. Part 2, Vol. xlvii. *From the Society.*

MEXICO, Boletin del Instituto Geologico de. Num. 15. Las Rhyolitas de Mexico. Mexico, 1901. *From the Director.*

MICROSCOPICAL Society, Journal of the Royal. Parts 2, 3, 4, 5, 6, 1902. Part 1, 1903. *From the Society.*

MONTANA, Bulletin of the University of. Summer Birds of Flathead Lake, by P. M. Silloway, 1901. *From the University.*

MOSCOU, Bulletin de la Société Impériale des Naturalistes, Année 1901. Nos. 3 and 4. *From the Society.*

MUSÉUM d'Histoire Naturelle des Pays-Bas. Revue méthodique et critique de la Collection des Oiseaux, par H. Schlegel. In 4 vols. 8vo. Leyde, 1862—80. *From Mr. J. H. Gurney, F.Z.S.*

MY Nature Note-Book, by E. Kay Robinson, London, 1903. *From the Author.*

NORTHANTS Natural History Society, Journal of the. Vol. xi., nos. 85—88., 1901. *From the Society.*

NORTH STAFFORDSHIRE Field Club. Annual Report and Transactions. 1901—1902. Vol. xxxvi. *From the Club.*

NORTHUMBERLAND, Durham, and Newcastle-upon-Tyne, Natural History and Transactions of. Vol. xii. Part 2. Vol. xiv. Part 1. *From the Society.*

NEW ZEALAND Institute, Vol. xxxiv., 1901. Wellington, N. Z. *From the Institute.*

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NOTES sur les Fourmis et les Guêpes par Charles Janet.
From the Author.

NOVA SCOTIAN Institute of Science. Proceedings and Transactions of. Vol. x. Part 3. Session 1900—01. *From the Institute.*

PETERBOROUGH Natural History, etc., Society. Precis of Thirtieth Annual Report, 1901. *From the Society.*

PLYMOUTH Institution and Devon and Cornwall Nat. Hist. Soc. Annual Report. Plymouth, 1901. *From the Institution.*

ROYAL Institution of Great Britain, Proceedings of. Part 3. Vol. xvi. London, 1902. *From the Institution.*

ROYAL Physical Society, Proceedings of the. Session 1900—1901. Edinburgh, 1902. *From the Society.*

SCIENTIFIC and Learned Societies of Great Britain and Ireland, Official Year-Book of the. London, 1901.
Purchased by the Society.

SCOTTISH Naturalist, The. Vols. i.—vi., 1871—82.
From Mr. J. H. Gurney, F.Z.S.

SMITHSONIAN Institution, Annnal Report of. Washington, 1902.
From the Institution.

SOUFRIERE, in St. Vincent, in 1902, Report on the Eruptions of the, and on a Visit to Montagne Pelee, in Martinique. Part 1, by Tempest Anderson, M.D., B.Sc., F.G.S., and John S. Flett, M.A., D.Sc., F.R.S.E. Phil. Trans. of Royal Society.
From Dr. Tempest Anderson.

SOUTH LONDON Entomological and Natural History Society, Proceedings of the, for 1901. *From the Society.*

SOUTHPORT Society of Natural Science. Sixth Report, 1900—01. Seventh Report, 1901—02. *From the Society.*

UNITED STATES Department of Agriculture. North American Fauna, nos. 20, 21, 22. Washington, 1902.
From United States Department of Agriculture.

——— Geological Survey. Twenty-first Annual Report, 1899—1900. Parts 5 and 7, and Maps to Part 5. Washington, 1900-1.
From the Director.

——— Reconnaissances of Cape Nome and Norton Bay Regions, Alaska in 1900. Geology and Mineral Resources of Copper River District Alaska, Washington, 1901. *From the Director.*

——— Geological Survey. Mineral Resources of the United States, by David T. Day, Washington, 1901. *From the Director.*

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United States Geological Survey. Bulletins of the, nos. 177—190, 192—194. Washington, 1901—2. *From the Director.*

——— Geological Survey. Glacial Formations and Drainage Features of the Erie and Ohio Basins, by Frank Leverett. Washington, 1902. *From the Director.*

Upsala, Bulletin of the Geological Institution of. Part 2. Vol. v. Upsala, 1902. *From the Institution.*

Wight, Natural History of Isle of, by G. A. Martin, M.D. London, 1849. *From Mr. J. H. Gurney, F.Z.S.*

Yorkshire Naturalists' Union, Transactions of the. Parts 26, 27, 1900. *From the Union.*

——— The Alga-Flora of, by W. West, F.L.S., and G. S. West, B.A., A.R.C.S. *From the Yorkshire Naturalists' Union.*

——— Naturalist, The. 2 vols. 1895—96, 1897—98. *From Mr. J. H. Gurney, F.Z.S.*

Zoological Society, Catalogue of the Library of. London, 1887. *From Mr. J. H. Gurney, F.Z.S.*

——— Society, Report of Council, for 1901. *From Col. Feilden, C.B.*

Zoologist, The. A Monthly Journal of Natural History, 1902—3. *From Mr. G. F. Buxton, F.Z.S*

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SIMILARITY OF ANIMALS DISTRIBUTED OVER THE SOUTHERN CONTINENTS.

2 1

MIOLANIA FROM AUSTRALIA,

COMPARED WITH

3

MIOLANIA FROM S. AMERICA.

THE GREAT HORNED CHELONIAN (*Miolania*)

Fig. 1. Front view of skull and (2) side view of tail-sheath, of *Miolania oweni* (greatly reduced in size), from the Pleistocene Deposits of Queensland, Australia.

Fig. 3. Front view of skull, with the lower jaw in place, of *Miolania* from Patagonia Argentina (greatly reduced in size), original in the La Plata Museum.

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P.S.—Those who are interested in following up the suggestions of this Address and inquiring further as to the special members of the Fauna and Flora of the Southern lands and their inter-relations, will do well to read Dr. H. O. Forbes' paper read before the Royal Geographical Society, March 13th, 1893, entitled: "The Chatham Islands: their relation to a former Southern Continent" (Supplementary Papers Royal Geographical Society's Journal, vol. iii. part 4, 1893, pp. 607–637), to which the author desires to acknowledge his indebtedness for many interesting facts recorded by him.

H. W.

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ADDRESS.

Read by the President, HENRY WOODWARD, LL.D., F.R.S., V.P.Z.S., F.G.S., Late Keeper of Geology, British Museum, *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-fourth Annual Meeting, held at the Norwich Castle-Museum, March 31st, 1903.*

LADIES AND GENTLEMEN—In occupying this chair to-night, I feel somewhat like a stranger amongst you although known personally to a good many of your members. It has been (as you are aware) occasionally the practice of this Society, to elect as its President, some scientific man living at a distance: under these circumstances I was assured that an occasional visit would be accepted as a sufficient compliance with duty. I accordingly planned to be present and read a paper last November, but was unfortunately prevented from attending at the last moment, and the paper was read for me by my friend Mr. F. W. Harmer. To-night, however, I am here to deliver my address as your President, in person, and to thank you for your past forbearance and kindness towards myself.

As you have just heard from the Treasurer, the finances of the Society are in a fairly satisfactory condition, though owing to the heavy expense entailed by the last part of the 'Transactions,' we have had to draw £20 from the Life Membership Fund, in order to meet all liabilities. We have had to use some of the capital towards the expenditure of the year. However, I regard it as a sign of the vitality of a Society, rather to exceed its income, than to accumulate funds for which it cannot find an outlet.

The number of members now stands at 271, showing a slight increase over last year. We have lost, by death, the Earl of Kimberley, and Mr. H. D. Geldart, both Vice-Presidents of the

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Society, also Mr. Francis Dix, Lord Cranworth, Mr. J. Nigel Gurney, and Dr. John Lowe; obituary notices of whom will appear in due course.

Our library is increasing rapidly. We have received donations of books and papers from Mr. J. H. Gurney, Colonel Feilden, Mr. H. G. Barclay, Mr. G. F. Buxton, Mr. C. G. Barrett, Mr. T. Southwell, Mr. F. W. Harmer, Mr. J. A. Harvie-Brown, Dr. H. Woodward, Mr. E. Kay Robinson, M. Charles Janet. Sir J. D. Hooker has also sent us a Sketch of the Life of Sir W. J. Hooker, and a medallion of Linnæus. The latter has been framed and hung in the Committee Room of the Castle-Museum. In addition to the above, we have received, as usual, the publications of a large number of Societies, with whom we exchange. I would draw your attention also to the increasing number of American publications received, especially to the Reports of the Smithsonian Institution, and those of the United States Geological Survey.

Last January, Major E. F. Becher presented the Society with a large number of Bird-skins, from India and the Mediterranean. These skins, which were in very fine condition, were examined by Mr. J. H. Gurney and Mr. Southwell. It was decided by the Committee that 187 of the skins should be presented to the Norwich Castle-Museum, and the remainder to the Yarmouth Museum, through the Hon.-Secretary of our Great Yarmouth Section.

At the April Meeting in last year Mr. F. D. Longe read a paper on "Protoplasm and Automatism," and Mr. W. Ayrton, who was introduced by the Hon. Secretary, exhibited some drawings of the earlier stages in the life history of various fishes, also, coloured sketches of Stephanoceros, Melicerta, etc. Mr. Thouless read a short entomological note.

In May Mr. J. T. Hotblack discussed a paper on "The Soils and Subsoils of Norfolk," by Mr. H. B. Woodward, F.R.S., F.G.S.

On 14th August an excursion of the members was undertaken to Whitwell Common. About ten members and friends formed the party, and some botanising was done.

On 30th September Rev. A. Miles Moss read a paper, entitled, "Three Weeks' Holiday among the Butterflies of Switzerland."

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On 20th October Mr. T. Southwell contributed an account of a Diary kept in 1800—01, by the late Rev. Dr. Sutton, at Holme-next-the-Sea. Mr. Arthur Bennett, F.L.S., sent a paper on "The Distribution of *Peucedanum palustre* and *Lathyrus palustris* in Britain." Mr. F. Long made some remarks on an unusual form of *Mentha piperita* found in Norfolk, and Mr. Patterson read some "Notes from Yarmouth."

On 25th November Mr. F. W. Harmer, F.G.S., read a paper by the President on "East Anglian Geology," illustrated by lantern slides, and Mr. J. H. Gurney, F.Z.S., exhibited photographs of the Bass Rock during the nesting season of the Gannets.

At the meeting on 27th January, 1903, Mr. W. G. Clarke sent a paper on "The Meres of Wretham Heath," which was read by Mr. F. Leney. Other papers were, "*Pyrola rotundifolia*, Lin. in East Anglia," by Mr. A. Bennett, F.L.S.; A List of "Flowers, Fungi, and Mosses," from N.W. Norfolk, by Rev. W. E. Thompson; Entomological Notes by Mr. W. H. Tuck; Winter Notes by Mr. Patterson; and Mr. F. Long exhibited some Botanical Specimens mounted by himself.

On 24th February Mr. A. W. Preston, F. R. Met. Soc., read his "Meteorological Notes" for 1902; Mr. T. J. Wigg, "Notes on Herring Fishery" for 1902; and Mr. J. H. Gurney, F.Z.S., sent a Note on the nest of a Siberian Jay.

The subject I intend to bring before you to-night is:—

THE DISTRIBUTION OF LIFE IN ANTARCTIC LANDS.

Introductory—Glacial and Interglacial Periods.

During the past sixty years, Astronomers, Physicists, Meteorologists, and Geologists, have all laboured to elucidate the causes and extent of the *Glacial period*, or to speak more correctly—*periods*.

It seems certain that such epochs have been, *in great measure*, brought about by a combination of astronomical causes, such as the inclination of the earth's axis, the ellipticity of her orbit, and her position in relation to the sun in perihelion and aphelion. But to whatever combination of causes such alterations of climate in the

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northern and southern regions of our globe may be due, we have a right to demand from the astronomers and physicists the concession, that mild interglacial periods *of considerable duration* must have prevailed at or near the poles, certainly within Tertiary times. Sir Robert Ball says: "It is essential to the astronomical theory of the Ice Age that such interglacial and glacial periods must have alternated with one another at the opposite poles of our earth."

The facts of the occurrence of extensive beds of coal and lignite, associated with shale-beds rich in leaves of dicotyledonous trees and shrubs in Arctic America, in North Greenland, Spitzbergen, &c., within the Arctic circle; and beds of coal with abundant tree-trunks in Kerguelen's Island,* Chatham Islands,† &c., in the Antarctic, *where no trees now exist*, testifies to great changes of temperature in the circumpolar regions of our earth, such as would, if they recurred, render these lands again habitable by plants and animals belonging to warmer temperatures, and greatly reduce, if not entirely remove, all traces of snow and ice over these areas.

Let us take a glance at the two polar regions of our earth. First: let us note the fundamental difference between Arctic and Antarctic conditions as regards topography.

In the *Northern Hemisphere* there is *a polar sea* almost completely *surrounded by continental land*, and continental conditions for the most part prevail.

In the *Southern Hemisphere* there is *almost certainly a continent at the South Pole*, which is *completely surrounded by the ocean*, and the most simple and extended oceanic conditions are met with.

Below the parallel of 40° South latitude, lie, Tasmania, the South Island of New Zealand, numerous small Islands (such as the Chatham Islands, Auckland Island, Campbell Island, Kerguelen Island, Heard Island, Prince Edward Islands, Tristan da Cunha, Gough Island, Bouvet Island, South Georgia, Sandwich Group, South Shetland Islands, Falkland Islands), and about 1500 miles linear of the South American Continent and Cape Horn. At the pole itself lies the great unexplored Antarctic Continent, surrounded

* 50° S. Lat. Kerguelen's Island. † 45° S. Lat. (Chatham Islands).

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by the vast waters of the Southern Ocean, covering an area of 30,000,000 square miles. Over the area, south of the parallel of 50° S. latitude, a temperature below 32° Fahr. prevails.

Atmosphere.

South of latitude 45° S. we meet with low atmospheric pressure all the year with *strong westerly and north-westerly winds*, and large rain and snow-fall *all round* the *South Polar* regions. The mean pressure being *less than 29 inches*. But there are many indications that the extreme South Polar area is occupied by a vast *anticyclone*, out of which winds blow, towards the girdle of low pressure outside the ice-bound region.

Ross found a gradual rise of pressure south of latitude 75° S., and all antarctic voyagers agree that *when near the ice*, the majority of winds are from the *south and south-east*, and bring clear weather with a fall of temperature, while northerly winds bring thick fogs with rising temperature.

Antarctic Ice.—The most striking feature of the Antarctic is *the huge table-shaped icebergs*. These flat-topped icebergs have a thickness of 1200 to 1500 feet, marked by regular stratification, and presenting lofty *perpendicular cliffs*, which rise 150 to 200 feet above, and sink 1100 or 1400 feet below the level of the sea.

Their form and structure clearly indicates that they were *formed on an extended land surface*, and have been pushed out over low-lying coasts into the sea.

Ross sailed for *300 miles* along the face of a great ice-barrier from 150 to 200 feet high, off which he obtained depths of 1800 and 2400 feet. This was evidently the sea front of a great creeping glacier or ice-cap just then in the condition to give birth to those table-shaped icebergs, *miles in length*, which have been described by every antarctic voyager.

But all the Antarctic land is *not surrounded by inaccessible cliffs of ice*, for along the seaward face of the great mountain ranges of Victoria Land, the ice and snow which descends to the sea, apparently forms cliffs not higher than ten to twenty feet, and in

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1895, Kristensen and Borchgrevink landed at Cape Adare on a pebbly beach, occupied by a Penguin rookery, without encountering any land-ice descending to the sea.

Where a Penguin-rookery is situated, we may be quite sure that there is open water for a considerable portion of the year, and consequently landing might be effected without much difficulty or delay. A party once landed might with safety winter at such a spot, where Penguins would furnish an abundant supply of food and fuel.

A properly equipped party of observers situated at a point like this on the Antarctic Continent for one or two winters might carry out a most valuable series of observations, make successful excursions towards the interior and bring back valuable information as to the probable thickness of the ice-cap, its temperature at different levels, its rate of accumulation, and its motion. As to the evidence of an Antarctic Continent, the form and structure of the Antarctic icebergs, show that they were built up on and had flowed over an extensive land surface. As they float north and break up in warmer latitudes they distribute over the floor of the ocean large quantities of glaciated rock-fragments and land detritus.

These materials have been dredged up by the "Challenger" in considerable quantities, and show the rocks of this land to be gneisses, granites, mica-schists, quartz-diorites, sandstones, limestones, and shales; indicating continental land, and were clearly transported from land at the South Pole.

Rocks.

D'Urville describes rocky islets off Adélie Land composed of *granite and gneiss.*

Wilkes found on an iceberg, near the same place, boulders of red sandstone and basalt.

Borchgrevink and Bull fragments of mica-schists and other continental rocks from Cape Adare.

Dr. Donald brought back a piece of red jasper or chert containing *Radiolaria*, and Sponge spicules from Joinville Island.

Captain Larsen brought from Seymour Island pieces of fossil

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coniferous wood, and fossil shells of *Cucullæa*, *Cytherœa*, *Cyprina*, *Teredo, and Naticæ*, having a close resemblance to species of lower Tertiary age in Patagonia, &c. These fossil remains indicate a much warmer climate in these areas in times past.

It is not to be expected that *a living land-fauna* will now be discovered beyond the Penguin rookeries. *Fossils* will, however, throw important light upon the age of the Antarctic land.

As Tertiary, Mesozoic, and Palæozoic Fossils have been freely met with in Arctic regions, we are justified in anticipating the discovery of like forms on the Antarctic lands, with corresponding former climatic changes, such as the presence of these forms of life would demand.*

Kerguelen Islands, Lat. 49°20′S. Long. 69°24′E.

In Sir James Clark Ross's voyage to the Antarctic (1847, 2 vols. Murray), he visited the Island of Kerguelen in 1840, and records the occurrence of a bed of Coal, *four feet thick* and forty feet in length (exposed), near Arched Point, *Christmas Harbour*, thirty feet above the sea, and covered by basalt. On the north side of the bay formed by Cape François, is a thin seam of coal (two or three inches in thickness) covered by a kind of "slag" and by basalt. Silicified trunks of trees are also met with, some of which (brought home by Sir Joseph Hooker) are preserved in the British Museum.

The coal is described as slaty, of a brownish-black colour, and the fracture is like wood-coal. Both the wood and the coal-seam are probably of Tertiary age. (A trunk of a large tree, seven feet in circumference, and much silicified, was dug out of soil below the basalt.) The wood, which for the most part is highly silicified, is found enclosed in the basalt, whilst the coal crops out in ravines, in close contact with the overlying porphyritic and amygdaloidal greenstone.

Ross mentions another bed of coal in Cumberland Bay, one foot in thickness (light and friable with a black glossy fracture like cannel coal, which does not soil the fingers). It is covered by a porphyritic amygdaloidal and greenstone rock. Another bed of coal

* See Sir John Murray: Proc. Roy. Soc., 1898, vol. lxii. pp. 424—451.

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in an adjacent hill is two feet thick, of a dull brownish black colour; and it is said to burn very well.

When Captain Cook visited Kerguelen *in the height of summer* (1768), *the land was covered with snow*, and only five plants in flower were collected.

The observations were made by Surgeon Robert McCormick and Assistant-Surgeon Joseph D. Hooker, of the "Erebus" (1839–43). Hooker records 150 living plants (18 flowering plants, 3 ferns, 25 mosses, 10 *Jungermanniæ*, 1 fungus, the rest (93) lichens and seaweeds).

Mr. R. McCormick who accompanied Ross, wrote:—"*Since the successive overflowings of volcanic matter destroyed the forests which at one period clothed this land*, of which the fossil trees and numerous beds of coal afford abundant proof, it has remained in a state of almost vegetable desolation ever since."

Writing of Victoria Land, Sir James Ross in February, 1841, said: "Had it been possible to have found a place of security upon any part of this coast where we might have wintered in sight of the brilliant burning mountain (*Erebus*), and at so short a distance from the magnetic pole; both of these interesting spots might easily have been reached by travelling parties in the following spring. It was, however, some satisfaction to know that we had approached the pole some hundreds of miles nearer than any of our predecessors."

And here I may record that on March 26th, 1903, Relief Ship "Morning" sends us good news from Port Lyttleton, New Zealand; and we know that Commander Scott with his crew in the "Discovery," entered the Antarctic Ice-pack on 23rd December, 1901, lat. 67° South, reached Cape Adare on 9th January, 1902, Wood Bay on 18th January, and landed on 20th in an excellent harbour, lat. 76° 30 m. South, visited Cape Crozier on 22nd, examined the Ice Barrier, and took soundings in long. 165° and found that the ice-barrier trended northwards. High snow slopes rose towards the glaciated lands with occasional bare precipitous peaks. They followed the coast as far as lat. 76°, long. 150° 30 min.; and then retired to *Winter Quarters* in McMurdo Bay, Victoria Land.

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Sledge-parties reached lat. 80° 17 min. South, the furthest point ever attained. Ranges of high mountains were seen to continue through Victoria Land. Foothills resembling the Admiralty range were observed at 160°. Lowest temperature 62° below zero!

Dr. J. W. Gregory, F.R.S. ('Nature,' April 25th, 1901), following Bernacchi's Topography of South Victoria Land (R. G. Soc., March 18th, 1901) suggested various problems for the "Discovery" to work out.

(*a.*) Whether the Antarctic Lands to the South of Australia, Victoria Land, Wilkes' Land, Adélie Land, Geikie Land, Newnes Land, Termination Land, are all part of one great continent, or members of an Antarctic Archipelago.

The earlier voyagers all maintained the existence of an *Antarctic Continent*, and Suess' theory supports this view.

Ritter suggests that the Volcanic chain forming the Eastern face of Victoria Land is the continuation of the New Zealand volcanic line, and that the coast of Wilkes' Land is a southern extension of the Australian plateau. This plateau is bounded to the north and east by the great fold passing through New Guinea, New Caledonia, and New Zealand.

The rocks dredged by the "Challenger" and the "Valdivia" are like those of Southern Australia; and those of Victoria Land examined by Teall, are like the rocks of New Zealand. Geologically then the Antarctic is an Archæan land with rocks similar to those of Australia; and its eastern side is volcanic.

Indirect evidence favours a *land connection* with a chain of peaks stretching from Victoria Land and the vicinity of Mounts Erebus and Terror to Graham's Land.

If this great line can be proved, the volcanic chain encircling the Pacific Ocean will be rendered complete, joining up the Antarctic land with New Zealand and Australia on the one hand, and Graham's Land to South America on the other. We do not expect a land fauna on the Antarctic, but Secondary and Tertiary fossils may be discovered, and furnish still further evidence of an old land connection.

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Correspondence in North and South Conditions, or, "Bipolarity," and Bipolar Faunas.

There is an interesting question too, in reference to the littoral and shallow water fauna and flora of the Antarctic lands as compared with the Arctic.

The *Sirenia* are represented in the south by *Halicore australis*, off the coast of Queensland, Australia, 30° only south of the equator, whilst *Rhytina gigas* (= *R. Stelleri*) occurs in peat-deposits on Behring Island, and *was living in numbers around its shores as lately as 1750*, 60° north of the equator. Probably in earlier times *Halicore*, or its allies, may have extended southwards to the shores and islands of the Antarctic lands.*

Of the Cetacea, the genus *Balæna* is represented in the Arctic Seas by *B. mysticetus*, *B. biscayensis* occurring in the North Atlantic and *B. japonica* in the North Pacific, the South Atlantic having *Balæna australis*, and the South Pacific *B. antipodarum* and *B. novæ-Zealandiæ*.

Of the *Pinnipedia*, Seals and Walruses, the Northern Sea Lion, *Otaria stelleri*, the largest of the genus, ten feet long, from the North Pacific is represented by *Otaria jubata*, the Patagonian and Southern "Sea Lion," and some other corresponding species as *O. californiana* (California) and *O. ursina*, North Pacific, Prybiloff Island; *O. pusilla*, Cape of Good Hope; *O. forsteri* and others from Australia. The Walrus (*Trichechus*) is *only found in the Arctic Seas*, North Atlantic, and North Pacific Oceans.

The true Seal (*Phoca*) is common to the North Atlantic and the North Pacific Coasts, but does not occur in the Southern Ocean.

"The Sea-Leopard" *Ogmorhinus* occupies the Antarctic and Southern temperate seas.

The Elephant Seal (*Macrorhinus*) or Sea Elephant, *the largest of the whole family* (*twenty feet long*), was formerly abundant in the Antarctic Seas and also found on the coast of California.

* According to Ross and many other explorers, great banks of *Laminaria* and other sea-weeds, similar to those around Behring Island, on which the *Rhytina* fed, abound in the South Polar Seas.

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The Honourable Walter Rothschild lately obtained one, at great expense, and presented it to the National Museum.

The Penguins (Impennes) may be said to represent in the Southern Ocean the Auks and Divers of the Northern Seas.

Whether these are *all* (as the Penguins and Auks are,) *merely representative forms*, or whether they may have in some cases been able to cross the equatorial region and reach the Arctic from the Antarctic is an open question. Certain deep-sea water forms of Crustacea may have done so along lines of cold currents in the ocean, but this does not so easily explain the presence of shore and surface-dwelling forms of life having a common facies if not an actual close family relationship. Still, it must be borne in mind that, cold polar currents do reach near to the equator on the South American Chilian Coast. The Sea Lions and the Elephant Seal have thus, in all probability, been enabled to "cross the line."

Antarctica in connection with the Neighbouring Land-areas.

Fifty years ago there were very few men of science bold enough either to suggest or to accept the theory that *the Geographical Distribution of Plants and Animals* had actually commenced far back in past geological time.

Professor Edward Forbes, S. P. Woodward, Darwin, Wallace, Huxley, Sclater, Blanford, H. O. Forbes, and others, have advocated these views, but they have become greatly modified in our own day since the time at which they were first expressed.

Australia was deemed to be a survival from the Jurassic period, *New Zealand* from the Triassic, and so on.* Australia is now known to possess representatives of almost every formation from Cambrian and Silurian times, to the Tertiary.

The fact remains that the Flora and Fauna of Australia and New Zealand present remarkable characteristics which, until lately, were believed not to exist, on any other part of the earth's surface.

* The great Struthious (wingless) birds of New Zealand were formerly supposed to be the descendants of the makers of the tridactyle footprints left upon the slabs of Triassic sandstone in the Connecticut Valley and elsewhere. These footprints have been described by the late Professor O. C. Marsh, and shown to have been left by bipedal Dinosaurian reptiles, which were living in the Triassic Period, before birds had made their appearance.

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IN FAVOUR OF A SOUTHERN CONNEXION OF ANTARCTIC LANDS.

A. R. WALLACE in 'Island Life,' says:—"Whenever we find a considerable number of the Mammals [*or flightless birds*] of two countries that exhibit distinct marks of relationship, we may be sure that an actual land-connection, or a close approach to one, has at one time existed."

CHARLES DARWIN ('Origin of Species,' vol. ii., p. 190, 1888,) says:—"New Zealand is plainly related to South America, although the next nearest continent is so enormously remote that the fact becomes an anomaly. This difficulty disappears in the view that New Zealand, South America, and the other Southern lands have been stocked in part from the Antarctic Islands, when they were clothed with vegetation during a warmer Tertiary period, before the commencement of the last Glacial epoch."

DR. W. T. BLANFORD, F.R.S. (Pres. Geol. Soc. 1890) wrote in his address:—"The biological evidence of a former land connection between South America and Africa is very strong, and if the difficulty about the *depth* of the intervening ocean is overcome, there is no improbability in the suggestion that, at some period of geological history, an important continent having connections with South America, South Africa, and New Zealand, may have occupied the Antarctic Area."

PROFESSOR HUXLEY "On the Distribution of Gallinaceous Birds," P.Z.S., 1868, says:—"Of the two sections (the *Alectropodes* and the *Peristeropodes*), the former are restricted to the Northern, and the latter to the Southern Hemisphere." He goes on to compare the Curassows of South America with the Megapodes or Mound-builders of Australia; and he considers that they are sprung from one stock; and that the common ancestors must have developed on some large area in the Southern Hemisphere, from which there was access both to South America and Australia.

PROFESSOR W. K. PARKER compares the Crows' skulls, or *Egithognathous* birds, and finds that the "*Lyre-birds*" of Australia are much more closely related to the *Tinamous* than to the modern forms. The "Jacanas" (Rallidæ): South America, Africa, India, Australia. The African Secretary-bird (*Serpentarius secretarius*), is

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represented by the *Caracara* of Central and South America, and more closely by the *Cariama* (*Cariama cristata*), which has its fossil representative in the gigantic form, named *Phororhacos*, from Patagonia.

It is probable that a very large extent of ancient land around the present Antarctic continent has been lost to us by submergence, and that the rather numerous small islands in the surrounding ocean are but the buoys or land-marks indicating large areas of more or less, continuous land, which has since disappeared. This is supported by the many signs of volcanic activity in recent times which these islands display. Doubtless land connections stretched from South America, to the South Shetlands, the South Orkneys, South Georgia, and to Kerguelen Island.

Peculiarities of Southern Land-Faunas.

Let us look for a moment at the peculiarities of the Southern Land-faunas:—

In no other part of the world do we find such a remarkable assemblage of struthious birds, both of living and extinct forms, distributed over the continents and islands which encircle the Antarctic. In South America, we have the *Rhea americana*. In Africa, the Ostrich *Struthio camelus*. In Mauritius we have numerous (8) species of *Æpyornis* (an extinct wingless bird as large as the *Dinornis* of New Zealand), remarkable also from the great size of its eggs. In Mauritius we find the extinct Woodhen *Aphanapteryx*. In Rodriguez nearly the same form, *Erythromachus*, was also once common. In Australia we have the Emeu and Cassowary living, and the extinct *Dromornis* and *Genyornis*. In New Zealand about twenty species of *Dinornis*, or "Moa," the largest attaining a height of at least twelve feet, were once *most abundant*, and peopled both islands (as the presence of their bones everywhere testifies) but have now been entirely exterminated by the Maoris as the similar large bird, the *Æpyornis* was destroyed by the natives in Madagascar. The surviving form is the "Kiwi" or *Apteryx*, which is also found fossil (*Diaphorapteryx*) in the Chatham Islands 500 miles to the east of Port Lyttelton, New Zealand. *Cabalus*, a flightless Crake, akin to the Woodhens, also survives in

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the Chatham Islands. This *Cabalus* occurs also on Lord Howe Island, 300 miles off the Coast of Eastern Australia to the far north west of Chatham Island.

Of other flightless birds, we have the *Aptornis defossor*, a large extinct Rail, and Mantell's *Notornis*, recently killed off in New Zealand, a *Porphyrio* also in New Zealand and Norfolk Island.

The Penguins, of which many species are known, occur on the Islands and Continents of all the Southern lands, just as the Great Auk was at one time distributed around all the circumpolar lands in the Northern Hemisphere, but the Great Auk was not found within the Arctic circle.

AUSTRALIA possesses a peculiar existing fauna belonging to the *Monotremata* and *Marsupialia*. The former: *Ornithorhynchus* and *Echidna* represent the sole surviving forms of the lowest division of the Mammalia, viz., the PROTOTHERIA, and to the order, *Monotremata* (egg-laying Mammals), which are confined to Australasia (New Guinea, Australia, and Tasmania). The latter comprising the pouched Mammals, known as the Kangaroos, Wombats, Dasyure, Thylacine, Rat-Kangaroo; *Macropus*, Rock-Wallabies (*Petrogale*), Hare-Wallaby (*Lagorchestes*), *Dorcopsis*, *Dendrologus* (Tree-Kangaroo); *Bettongia*, &c.

Fossil forms are numerous, some like *Diprotodon* and *Nototherium* far exceeding the living forms in size. There are also many other fossil genera, described by Owen, such as *Sthenurus*, *Procoptodon*, *Palorchestes*. In *Diprotodon*, the fore and hind limbs are not differentiated, but are of nearly equal length, and not adapted for rapid movement.

Added to these are the Phalangers, Cuscus, Flying Phalangers; the Koala; and the *extinct Thylacoleo carnifex*, most probably related to the Wombats (*Phascolomys*). Added to these are the Bandicoots (*Perameles*); the Tasmanian Wolf (*Thylacinus*); the Tasmanian Devil (*Dasyurus*); the Pouched Mole (*Notoryctes*); and the *Opossums* (*Didelphys*), common to America and Australia.

The curious and now almost extinct "Tuatara" Lizard (*Sphenodon* or *Hatteria*), now confined to an Islet off the North Island of New Zealand, formerly existed also in Chatham Islands 500 miles distant by sea.

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The most remarkable discovery of late years bearing upon the wide distribution of similar animals over the Southern Continents, is that of *Miolania*, an extinct genus of land Tortoise, the head of which is ornamented with peculiar bony plates, and the tail is encased in a bony sheath, resembling the tail of *Glyptodon*. The first example of *Miolania* was found in Queensland, Australia; the second on Lord Howe Island, 300 miles to the eastward of the Great Barrier Reef. The third example was lately obtained by Dr. Moreno in Argentina, South America! yet they can only be differentiated specifically, notwithstanding their enormously wide geographical separation from one another.

Amongst the Amphibia the *Cystognathidæ* occur in Australia, Tasmania, and South America.

Of Freshwater fishes we have the Southern "Salmon" *Haplochitonidæ*, and the Southern Pikes *Galaxiide*, common to New Zealand, Chili, Patagonia, and the Falkland Islands.

Again the remarkable *Dipnoi* and *Osteoglossi* are peculiar to the rivers of Africa, Australia, and South America, and are unknown north of the equator.

Peripatus is only known from the West Indies, from South America, South Africa, and Australia.

Among the *Scorpionidæ*, the genus *Cercophonius* is only met with in South-east Australia and in South America.

Placostylus, a genus of Land-Mollusc, is found in the Solomon Islands, in Fiji, the New Hebrides, Loyalty Island, New Caledonia, Norfolk Island, Lord Howe Island, and in New Zealand.

A summary of the Flora characteristic of the Southern Hemisphere fully confirms the conclusions derived from a study of the Fauna, and establishes beyond a doubt the former existence of extensive land-connections between the Southern Continents and Islands in Tertiary times which have since disappeared beneath the ocean.

PLANTÆ. SOUTHERN HEMISPHERE (*Notogæa*).

SAXIFRAGEÆ. Of the "Saxifrages" the genus *Donnatia* occurs in New Zealand, Tasmania, Chili, and Tierra del Fuego. *Escallonieæ*,

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17 genera met with in New Caledonia, Australia, and Tasmania. *Cunoniæ*, 18 genera common to New Zealand, Mascarene Islands, South Africa, and South America. Only two out of thirty-five genera cross the equator into the Northern Hemisphere.

PROTEACEÆ. The *Banksias* have 49 genera and 950 species. Only twenty-five cross the equator. The others belong to Madagascar, Tasmania, New Zealand, and New Caledonia. Some occur fossil in Miocene and Cretaceous Plant-beds in Europe.

MONOMIACEÆ (related to the Laurels) 22 genera and 150 species, have the same distribution as above. One genus, *Laurelia*, is common to Chili and New Zealand.

PERSEACEÆ, the genus *Cryptocarya*, is common to New Zealand, South Africa, and South America.

CONIFERÆ, *Callitris* is common to Africa, Madagascar, Australia. *Fitzroya* is common to Chili and Tasmania.

PODOCARPEÆ, 3 genera; distributed 1 in Tasmania, 1 in Chili and South America, and 1 South Africa, Australia, and New Zealand.

Todea barbara occurs at the Cape of Good Hope, and in Australia.

Lomaria alpina, occurs at the Cape, in Australia, and South America.

Fuschia and *Passiflora* are common to New Zealand and South America.

New Zealand and South America have 74 genera in common, 11 identical and 32 closely allied species.

That Earth-movements, on a widely extended scale, have occurred in the South, is evidened by the very late elevations and subsidences which have taken place in parts of the Andean chain and in Tierra-del-Fuego, also in Kerguelen Island, Eastern Australia, Tasmania, New Zealand, and the Chatham Islands; whilst the vast upheaval of the Himalayan range itself is only of newer Tertiary age.

Dr. Woodward's address was illustrated by about fifty-eight lantern slides, a great number of which were beautifully painted pictures of Birds by Külemann, kindly lent by Dr. H. O. Forbes, Director of the Liverpool Museum, and a series of Arctic views and maps kindly lent by the Royal Geographical Society, besides a number prepared expressly for his address, by Dr. H. Woodward.

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I.

THREE WEEKS' HOLIDAY AMONG THE BUTTERFLIES OF SWITZERLAND—JULY 5TH TO 30TH, 1902.

BY THE REV. A. MILES MOSS, M.A.

Read 30th September, 1902.

To attempt to give an account of the Butterflies of Switzerland after but a brief three weeks' holiday in that gorgeous country, so replete with its fauna and flora in endless variety, is rather more than *bordering* on presumption. Those three weeks, however, were to me weeks of hard labour in the Entomological sense, and of close and careful observation; and I think I may fairly add, by no means unattended with success.

It is on this account that I have with great pleasure responded to the Secretary's request, and have brought here this evening for your inspection four cabinet drawers containing my captures. I should like to say at once that they of course represent but the merest fraction of those seen, and, for one cause or another, not taken.

Confining oneself to the Butterflies proper, and for the present, at any rate, excluding the Moths, they will be found to contain some 68 species. I observed, in more or less abundance, some 14 others which I had no special desire to take; and there is little doubt that at different times and places several other species whose identity I cannot swear to were seen.

Here, in England, we have barely 60 species; Switzerland, I believe, possesses more than 170; so that I regard my net total of 82 for July as satisfactory and encouraging.

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After spending a few days in Dieppe, with which I do not now propose to deal, I journeyed, *via* Paris and Lausanne, to Villars near Bex, at the western extremity of the Rhone valley, reaching it at 5 p.m. on Saturday, July 5th. Here I stayed three weeks, leaving on Monday, July 27th, and concluding my holiday with a couple of days in the district of Zermatt.

After the miseries of a long cold night journeying from Paris, observations commenced through the window of the railway carriage. The snow-clad peaks of the Alps came in sight, the sun streamed forth in a cloudless sky, and the Butterflies were quickly on the wing.

Among the first to show up in considerable numbers were the Marbled Whites (*Melanargia galatea*) and the Ringlets (*Epinephele hyperanthus*).

Then, as though to tempt one to do something rash, the train pulled up for a minute at a luggage siding, and a magnificent specimen of *Limenitis populi* displayed its glory in a few graceful turns over a pile of stones right in front of my carriage window. Once and again it settled, and had my net been rigged up, I should certainly have got out, regardless of consequences. Such want of discretion was, however, outmatched by disability, and on we sped, leaving *populi* to enjoy its freedom, and reaching Bex about 1 p.m. Here there was not much to be done, and I was destined to wait two solid hours before the electric tram could make up its mind to toil up the steep incline to Villars, some 4,000 feet above sea level. The climb took another two hours, but the lethargic pace of the car was to some extent compensated by the gorgeous views which met one at every turn, and here the Butterflies began to show up in great force—Fritillaries, Vanessas, Whites, and Erebias appearing in almost the same profusion as the flowers which lined the banks. On reaching the hotel my first capture was *Aporia crataegi*—the Black-Veined White, a specimen of which I knocked down with my straw hat as I crossed the garden. This fly, now so rare in England, soon proved to be one of the commonest in the district. Entomology, however, had to be put aside for a time, for the primary object of my visit was to take charge of the little church at Villars as Chaplain for four Sundays, and it was now late on Saturday afternoon.

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Though I could not resist the temptation of boxing a nice specimen of *Scoria dealbata* which flew out of the grass on my way to church, Entomology proper began on Monday, and as there were no other bug-hunters in the place, I had it all to myself. As a matter of fact, I don't think my captures would have been seriously diminished if half the lepidopterists of Great Britain had been staying there.

Every field was full of flowers, and every flower seemed to have its Butterfly. I knew nothing of the place before starting, but it was very soon clear that it was an admirable hunting ground.

After the customary and, to the Englishman, highly unsatisfactory repast of coffee and rolls, I started off with my big balloon net and a knapsack full of pill boxes, a cyanide bottle, and corked zinc for pinning, intending to give the place a general survey. In an hour and a half I was back at the hotel, full up, having travelled but one hundred yards from the bottom of the grounds. I began to realise that there was work in store for me if I wished to get my insects set, and that I should have to exercise a considerable amount of discrimination in the matter of what to take and what to leave. After emptying my boxes I was off again, and returned with them once more quite full in good time for *déjeuner* at 12.30, and this after rejecting many specimens that I would have made a day's excursion for in England. This second trip carried me through sheer force of will about a quarter of a mile from the hotel. It was quite unnecessary to walk so far, for I believe I could have taken every species in the field immediately adjacent to the grounds.

Given a net and enough boxes I verily believe that if I had been penned up in that one undulating and flowery meadow I could have topped the whole British list in point of species in a remarkably short time.

The sun shone forth in all its splendour, the weather continued hot and fine, and though we had three excessively grand thunderstorms with deluging rain, it always seemed to pick up again. One expected that rain would polish the Butterflies off the face of the earth. There were, for the time at any rate, fewer stinging flies, which were generally an intolerable nuisance, and of course many delicate and wasted Butterflies must inevitably have perished.

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A generation of *passé* Mazarine Blues (*Lycaena acis*) seemed to have departed after the first big storm, but I was surprised to notice many species in excellent condition, notwithstanding the rain. Freshly-emerged specimens no doubt they were in many cases, but even *acis* turned up again quite fresh.

Day after day, morning and afternoon, I was employed in the same way, and much of the time very near the same place, rarely returning without a full bag, and I am bound to say the interest never once flagged. New species kept putting in an appearance, and scarce a day passed which did not afford me the indescribable pleasure of taking a thing for the first time—a fly that one had read of in books, and possibly seen in a museum collection, but which was now a living reality, and possessed of more than doubled interest.

I must now wade through a list of species taken, some of them on the heights above Villars—Chamossaire, Perche, Col de la Croix, and the neighbourhood of the Diablerets—but mainly near the road between Villars and Gryon—Gryon being a village of delightful Swiss chalets, about three miles down the chemin de fer, in the direction of Bex.

And first in the order of species comes our well-known Swallow-tail of the broads, but in Switzerland by no means confined to swamps. There he was, in company with the Red Admiral and Painted Lady, swirling over the dizzy precipice at the top of the Chamossaire mountain, an elevation of over 7,000 feet. I took him again near Gryon, and in the pass between the Diablerets and Argentines, but was apparently too late in the season for his congener *podalirius*. In the same pass I took a solitary specimen of *Parnassius delius*, first cousin to the famous *apollo*. Then *Aporia crataegi*, the Black-Veined White, was everywhere, and in excellent condition. One specimen I bred from a pupa found belted upon a twig of *Pyrus aria*. I contented myself with merely spotting the common Whites, and did not notice any of the smoky-coloured variety of *napi*, which goes by the name of *bryoniæ*. A single specimen of *Euchlöe belia* was netted near Gryon, and *cardamines*, the orange tip, appeared on several occasions. The Wood White, *Leucophasia sinapis*, turned up sparingly, and I dare say would have been common if worked for.

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There were plenty of *Colias hyale*, the pale clouded yellow, but they were not all in good condition; and I only detected *edusa* in the Rhone valley.

A nice series of *C. phicomone* were taken at the foot of the Argentines, and a few specimens of the Brimstone, *Gonepteryx rhamni*, were noted here and there. *Thecla rubi* was seen several times in poor and wasted condition. Then, turning to the *Lycaenidae*, I took three species of Coppers near Villars—our familiar friend *phlæas*, one worn specimen of *Polyommatus helle*, and a short but good series of *hippothöe*, with one under side variety, possessing two large and irregular black spots.

The Blues noted in the same district comprised the following: *Lycaena aegon*, *astrarche*, and *icarus*, all no doubt common had they been worked for; *L. corydon*—the chalk hill blue—very common after July 12th; the lovely sky-blue *hylas*, much like *adonis* on the upper surface, some worn, but several in perfect condition; the even more lovely *damon*, as fresh as a daisy, and plenty of them; *alsus*, a few; *acis* or *semiargus*, the commonest of all the Blues, and, as we have already said, in variable condition; *alcon*, one worn specimen; and last, a good and varied series of *arion*, the Large Blue. One worn specimen of *Nemeobius lucina* was netted and released. Among the *Nymphalidae* I only secured one much torn specimen of *Limenitis populi*, but saw others on several occasions when they were out of reach.

I was successful in finding eight pupæ of *L. camilla*—a Butterfly which strongly resembles our English White Admiral, but is even more intense and beautiful in its colouring. They were found hanging on the extremities of the twigs of a species of honeysuckle which grew abundantly in the woody undergrowth adjoining the hotel, and nothing could have so admirably resembled curled up dead leaves. Four of them emerged satisfactorily, one producing an *ichneumon* instead. *Vanessa levana* I think I detected from the railway carriage, but I cannot be quite sure as I did not catch any.

Grapta c-album was fairly common, but somewhat *passé*; *urticae*, as usual, was everywhere, and *atalanta* and *cardui* were common, especially over the top of mountain ridges. *Antiopa*,

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so inaptly described as the Camberwell Beauty, has the reputation of being a common Butterfly in that part of the world, but it surprised me by not showing up at all.

Next come the extremely interesting but no less confusing race of Fritillaries. *Militæa artemis*, one freshly emerged specimen; *cinxia*, several worn; *athalia*, and I think *dictynna*, very common everywhere; *euphrosyne*, common but *passé; pales*, common at a higher altitude; *dia*, fairly common; *amathusia*, very common, one in the larval state crawling with great speed in the hot sun on the banks of Lac des Chavonnes, and seeking a place to pupate. It fixed itself up for the purpose in the pill box before I got back to the hotel, and leaving it undisturbed, it emerged satisfactorily in Paris on the home journey. Also in the fields round Villars I took two fresh specimens of *Argynnis ino*. *A. lathonia* I noticed and missed on several occasions, only catching two near Perche. *A. aglaia* was common, and I caught one truly magnificent black variety, with the majority of the silver spots on the under surface, represented in deep bronze set in a dark green belt. It was taken casually as it flew across the road near the hotel, and for a moment I did not know what to make of it. It is in perfect condition, and as I carefully pinned it out I wished much that it was possible to show both sides. I find that the form is to some extent known, as one very much like it is figured in Curtis, from a specimen caught at Ipswich in 1827; but mine is, I believe, an even more striking variety. *A. niobe* was very common, though I have, apparently, taken only one of the silver-spotted form. *A. adippe*, too, was common, and one specimen which I set to show under-side, is very richly banded with brown.

A. paphia I ascertained was common in the district but it was evidently over.

Then, in the *Satyridae*, *Melanargia galatea* was one of the commonest Butterflies, and was accompanied in plenty by *Pararge maera*. I cannot recollect whether I noticed *P. megaera*, but *Satyrus semele* and *Epinephele ianira* were there, and *E. hyperanthus* in the greatest abundance. As to the *Erebias*, I am still in doubt as to the identification of some of my species. I believe I took nine, and some were very common. I certainly took good series of *E. melampus*, *manto*, *tyndarus*, *aethiops*, *ligea*, and one specimen

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of *euryale*. What the others are I cannot at present say for certain. I have also omitted another Villars Blue, which is nearly black on the upper surface, and which I cannot yet identify.

Caenonympha iphis, and I think *C. satyrion*, were taken in small numbers, and the ever abundant *pamphilus* left to enjoy freedom. On turning to the last order of the Butterflies, the *Hesperidae*, I am again in trouble. There was no doubt about the presence of *Hesperia sylvanus*, and *linea*, and *Nisoniades tages*, and I think I am safe in labelling one odd specimen *Spilothyrus althae*; but four others in the genus *Syricthus*, all more or less like one another, and like Mr. Lang's excellent figures in his work on the European Butterflies, are probably all different species, and defy my poor attempts at nomenclature. I wish I had had time to collect more, for there were plenty on the wing.

And now I must hurry on, and quickly enumerate the additional species which my two days' hunting about Zermatt afforded.

First comes the grand *Parnassius apollo*, perhaps the most characteristic of Swiss Butterflies. I feared that I should have to go home without it, but was saved at the eleventh hour by securing six or eight good specimens in the Visp valley below Zermatt. On the Riffel Alp I noticed *A. pales* again in some abundance, and higher up, in fact at the top of the Gornergrat, I took a good specimen of *Pieris callidice*, and rejected several others that were too much worn. No *P. daplidice* were seen. On returning by a short cut to the Findeln Glacier Hotel where I was staying, I took *Erebia tyndarus* and *manto*, one specimen of *Colias palaeno* in company with *phicomone*, and three specimens of the little Alpine Blue, *Lycaena orbitulus*. Had there been time I should have taken more, but its condition was distinctly shabby. Some very fresh specimens of *L. acis* were again noticed flitting over puddles in the road. A lovely fresh specimen of *Melitaea phoebe* was netted on the way down to Zermatt, and two specimens of a neat little fritillary, which I hope I am right in designating *M. parthenii*, also a small series of the Skipper, *Hesperia comma*. As the sun set behind the Matterhorn I found the grass blades and scrubby Juniper bushes on the banks of the Visp literally covered with a small species of Blue, which I at once put down as *aegon*, and only took a couple from the thousands which I saw.

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I now find that it is the next species *L. argus*, and I should have been glad of a series.

Amongst many others of which we have already spoken, and which I had no time to pay further attention to, I must not fail in conclusion to mention the Coppers. Some twenty of these gaudy little creatures were secured on the hill slope by a small rivulet between Findeln and Zermatt, and many others seen. Those I took were all together, and were all males, and I went away with the impression that they were all *Polyommatus virgaurae*. On closer investigation I found that I had undoubtedly got two species. Eight or nine were *virgaurae*, and the rest I have now come to the conclusion are not *rutilus*, but a local Alpine form of *hippothöe* without the purple sheen, which goes by the name of *eurybia*.

I had again taken an underside variety, the spots on the hind wings on one side only being elongated into narrow radial streaks.

To deal with the Moths on the present occasion would, I fear, make my paper disproportionately long and perhaps tedious. I will therefore content myself by merely exhibiting a few of the rarities which I took.

I conclude by confidently recommending both Villars and Zermatt as excellent holiday resorts for the lepidopterist.

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II.

LEAVES FROM AN OLD DIARY IN THE YEARS 1800–2.

By Thomas Southwell, F.Z.S., V.-P.

Read 28th October, 1902.

Perhaps there is nothing more interesting than an old note-book; whilst perusing its pages we seem to live again with the writer, and if it be of ancient date, for the time being identify ourselves with the knowledge of the subject then prevailing, passing in mental review the gradual steps by which a clearer light has dawned, and, it may be, more accurate knowledge has been developed.

Occasionally we come across passages which are like little rifts in the clouds that obscure the past, and even should the records not be of very great importance, still they are possessed of value for the light which they cast on the mode of life of our ancestors, their prevailing lines of thought, or the condition of the country and of its natural productions at the time they were penned. To no class of observations do these remarks apply more fully than to Natural History subjects, particularly when they relate to our own locality, and it seems to me highly desirable that such records should find a place in the 'Transactions' of our Society, where they will no longer be in danger of being lost.

Recently the Rev. J. W. Millard has been kind enough to lend me a fragmentary diary kept by the Rev. Dr. Sutton in the Autumns of 1800–2, in the parish of Holme-next-the-Sea, and although there is perhaps nothing very striking in the entries, they are still, I think, interesting from their local character and the frequent references to men celebrated in their generation as well as to events long past. Mr. Millard has therefore, at my request, been so good as to give me permission to lay them before our Society.

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The writer of the Diary, the Rev. Charles Sutton, D.D., is fully entitled to rank among the Norfolk Naturalists of the early part of the 19th century, but hitherto has met with very little recognition in that capacity. The son of Edward and Rebecca Sutton, he was born early in March, 1756, in the parish of St. Andrew's, Norwich, and educated at the Norwich Grammar School, at that time in the charge of Rev. George William Lemon as head master. In 1775 he was entered at St. John's College, Cambridge, and took his B.A. degree in 1779; he passed tenth Wrangler among an extraordinary number of distinguished men of his own College; of the seventeen Wranglers of that year no less than ten were of St. John's; among these were Bishop Marsh, Professor Christian, and Serjeant Lens. In due time he was elected a Fellow of his College, and proceeded to the degrees of M.A. in 1782, of B.D. in 1789, and of D.D. in 1806. In 1788 he was presented to the Perpetual Curacy of St. George, Tombland, by Dr. Yorke, Bishop of Ely. In 1793 he was presented to the Rectory of Alburgh, Norfolk, by Sir Richard Hill, Bart., which patronage is restricted to the Fellows of St. John's, but without regard to seniority; he was personally unknown to Sir Richard Hill, and owed his appointment to his reputation for zeal, diligence, and exemplary conduct in his professional duties. Soon after this he married Charlotte, the sister of the Rev. William Kirby, Rector of Barham, Suffolk, with whom he lived forty years in uninterrupted affection and happiness. In 1794 he was further presented to the Vicarage of Thornham-*cum*-Holme, *juxta mare*, by Charles Manners-Sutton, Bishop of Norwich.*

Dr. Sutton spent most of his time in Norwich, and took great interest in the charitable institutions of the City, with most of which his name was associated, and it was not until the year 1842 that he resigned the Perpetual Curacy of St. George, Tombland. He died on the 28th of May, 1846, at his residence in King Street, Norwich, in his 91st year, and was buried by his own request in

* An amusing anecdote is related with regard to this similarity of names Dr. Sutton who was on very friendly terms with his Bishop, on one occasion remarked to him, "I think, Bishop, there must be some family connection between us, the similarity of names is so remarkable," "Oh, no, that cannot be," replied his Lordship, "I quite admit the similarity of names, but, alas! you want the 'Manners.'"

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the churchyard of his Rectory of Alburgh, by the remains of his beloved wife, who pre-deceased him in the year 1832. For these particulars I am mainly indebted to the Rev. J. W. Millard.

Dr. Sutton was early attached to botanical pursuits, and to the study of Natural History in general as well as to antiquarian research; he contributed a monograph of the genus Orobanche, in which he established a new species *Orobanche elatior* (which had previously been confounded with *O. major*), to the Linnean Society, which was published in their 'Transactions' for 1798 (vol. iv. p. 173), where he is described as "B.D., A.L.S., Fellow of St. John's College, Cambridge," and Cotman's Plate of the South doorway of Wimbotsham Church is dedicated to him. His first and friendly instructor in Botany was John Pitchford, a surgeon of Norwich, who Sir J. E. Smith regarded as one of his oldest botanical friends, and the only survivor in 1804 of the Linnæan School of Norwich Botanists (T.L.S., vol vii. p. 295), and of whom Dr. Sutton always spoke in the warmest terms. He was in frequent communication with Sir J. E. Smith, and of course had constant opportunities of interchange of ideas with his distinguished brother-in-law, William Kirby, the entomologist, during a long period of mutual esteem. It is not known that he published anything except what appears in the Linnean Society's 'Transactions.' Such was the man from whose too brief note-book the extracts which follow were taken.

The note-book was only kept between August the 8th and October 22nd, 1800; August 5th and September 7th, 1801, and July 9th to August 9th, 1802, on which day the last entry occurs. It seems likely that he only recorded in it the events which occurred during his visits to his vicarage of Holme, in the autumn of each year; at other times he probably resided at Norwich.

The first entry in the note-book refers to an abominable practice which, in spite of every precaution, prevails to a serious extent in the present day. After mentioning that *Picus medius* or *P. minor* was seen upon the Plum tree before the parlour window under date of August 8th, 1800, he goes on to say:

"Dined with Mr. A. S. —— who told me that Mr. Brooks, the Bird dealer in Town, sends people into Norfolk to buy the Pheasants' eggs at 2s. per doz: which he puts under hens at his villa near Town. Mr. Rolfe told him it was supposed 2000 eggs had been

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sent out this year, the nests are found by means of Dogs. Qy. Since in mowing fields of Clover many nests of Pheasants are spoiled, would it not be right to turn a Pointer into such fields before mowing who might discover the nests so that the eggs might be preserved."

The original entry looks like 2 gs. (two guineas) per dozen, but I have ventured to interpret it two shillings. I have no idea what is paid for "poached eggs" in the present day, but 3s. 6d. an egg seems too high a price, not including the cost of collection which must have been considerable, and they would surely at a time when game was not so eagerly cultivated as it now is, be of less value than at present. The Mr. A. S. —— referred to was the Rev. Armine Styleman, Rector of Ringstead, and great-grandfather of Mr. le Strange of Hunstanton. He continued to reside at his Rectory after he came into the Hunstanton and Snettisham estates, and died there in 1803. Arthur Young mentions that "Mr. Styleman" farmed some 2000 acres of his own land in Snettisham, and speaks with approval of his enterprise, adding that he was the first in Norfolk to use the drill in sowing corn.

On the 11th of August Dr. Sutton writes: "Mr. Styleman told me he had an account somewhere of the havoc done at sea in the memorable storm in 1703, when the coast was covered with wreck from Snettisham to Cromer."

Mr. le Strange was good enough to look through the note-book of Sir Nicholas le Strange, who lived in the early years of the 18th century, but can find no mention of this storm; he has, however, some recollection of a small sketch in the margin of some diary or note-book, showing the sea dashing over Hunstanton Cliff, which must have been the result of a considerable storm. He sends me the following extract from Sir Nicholas le Strange's Note-book (part ii., p. 46) descriptive of a still earlier storm which occurred on the 2nd September, 1695:

"There rose up in the night a very dreadfull Storme & Tempest wch drove ashore the greatest p^{rt} of ye Southerne Collier Fleet then rideing over the Burnham Flatts & in the next morning the whole shore from Blakeney to Lynn was full of vessels aground & wreck. 3 disabled shipps were driven upon Holme Sands 1 large Yarmouth vessell upon the black rocks under ye Cliffe 3 upon Heacham Beach at ye greeve 3 more at ye entrance into ye Haven.

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1 great Ipswich vessell brake upon the gore but ye Ma^r^ & 21 men escaped in their long boat 1 other great London vessell strake upon ye sands & broke off Thornham and p^rt^ of her rigging came up at Holme wch I bought."*

This storm of 1703 was long referred to as the "Great Storm," it occurred in the night of the 26—7th of November (O.S.). By it the first Eddystone Light-house was destroyed, and many lives were lost, both at sea and on land. Dr. Kidder, Bishop of Bath and Wells, and his wife were killed by the fall of part of his palace. Addison refers to it in 'The Campaign,' in the following lines:—

> "So when an angel, by divine command,
> With rising tempests shakes a guilty land
> Such as of late o'er pale Britannia passed."
> (Works, edit. 1811, vol. i. p. 60).

A passage which called forth the caustic criticism of Thackeray in his 'English Humourists.'

Dr. Derham communicated an account of this storm to the Royal Society which was published in the 'Philosophical Transactions' for 1704. There are also some particulars in the 'Penny Magazine' for 1836, p. 490, and in 'Notes and Queries,' third series, vols. iii., v., and vii.

Dr. Sutton had an eye to the utilisation of the waste products of the ocean, as is evinced by the following extract dated August 13th, 1800: "Tythe taken at Thornham. An account of bushels of Asterias, [*Asterias rubens*, L. The common Star-fish or Five-finger of the Fishermen] taken in the Oister nets which it is thōt might be made an useful manure & might be had for 3^d^ a bushel."

* Mr. le Strange also sends me another extract from the same Note-book (p. 49), which is so curious that I cannot refrain from quoting it:

"Dec 11th 1705. A large Hamborough ffly boat haveing 2^d^ before struck upon some sand & slipt her rudder in ye channell, put ashore at ye Greeve her chief ffreight was 50 Red-Deer being a present from ye king of Russia to ye Duke of Newcastle & bound for Hull. The Deer were most in Deal cases fitted to their heights. The Staggs had their horns sawn off ab^t^ 6^in^ long from ye Burr. The old Deer were of a very large size and of a Badger color. The M^ar^ of the Vessell being judg'd a very careless & Knavish ffellow quitted his shipp & sold her whole, as she lay to Mr. W. &c., who design'd to have gott her off to sea the very next tide, if the Wind had not turned cross, but soon after took her away to Wells. *I mention this for ye curiosity* of the Lodeing, since she came up whole & went to sea againe."

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Under the same date occurs the following: "Wheat troubled with the Insect but [?] had none of the orange gum."

Dr. Sutton evidently here refers to the Wheat Midge, *Cecidomyia tritici*, Kirby, an insect infesting wheat during the period of its inflorescence, which was attracting a good deal of attention at that time from entomologists, and it is probable that his friend Kirby had asked his co-operation in the study of its habits and distribution, a task in which the latter was then engaged. The way in which the life history of this minute insect and its parasites was worked out by Marsham, Goodenough, Markwick, and Kirby, and their admirable papers on the subject, published in the 'Transactions' of the Linnean Society (vols. iii. and iv.), are a standing monument to their perseverance and capacity for critical observation, and a lasting object lesson to their followers.

Excellent coloured figures of the insect in its various stages of development, from drawings made for Sir Joseph Banks of Yorkshire specimens, are given in Vol. iii. of the 'Transactions,' Tab. 22. Kirby named this insect *Tipula tritica*, and an Ichneumon which made the larva the host in which to deposit its ovum, *Ichneumon tipulæ;* he subsequently discovered two other species of Ichneumon which also infested the larvae of this Fly; these three species Mr. James Edwards tells me are now known as *Leptacis tipulæ*, Kirby; *Isostasius inserens*, Kirby; and *Eurytoma penetrans*, Kirby. The "orange gum" mentioned, called by the farmers the "red gum," Dr. Plowright tells me is the Uredospore of *Puccinia glumarum*, formerly known as *Uredo glumarum*, a rust which attacks the ear of the wheat, and which, at a certain stage of its development, has the appearance of a yellow exudation or gum.

August 18. "Tythe dinn^{r} at Holme, Mr. Faircloth said that in large tides the water in the wells at Holme was known to rise sometimes 2 foot. Wells are supplied wth water sometimes by land springs & sometimes by private springs. He [Faircloth] is knowing about Bees & has hived 'em in skeps where the comb has been left by Bees wch have died."

— „ — 20th "Party at Hunstanton Cliff. Mem. The Cliff is 55 feet high being 5 higher than at Margate, Mr. N. Styleman measured it. Pleasant rain after 7 weeks continued drought."

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The Mr. Nicholas Styleman here mentioned was a younger son of the Rev. Armine Styleman. He lived at Heacham, and is there buried. The rainfall, according to the 'Gentleman's Magazine' for the two months, June and July, 1800, was only ·64 of an inch; in August, 1·40 inch fell, chiefly after the middle of the month.

August 21 "Found 2 or 3 Natterjacks, observe the yellow line down the back begins at the nose and ends at the vent." A further note on this subject will be found under date of 14th July, 1802.

August 27 "A Soland goose was shot lately at the beach here by Mr Elsdon; E. Renant this day (Aug 27th) shew'd it to me—it is a very powerful bird, it is *pelecanus bassanus* & agrees wth the description except the pouch being but slightly visible & the bill but little jagged—he called it a Herring Gant—the last word is a corruption of Gannet. There is a similar bird somt^{s} found out at sea call'd a Willock, of wch they report that it hatches its eggs und^{r} the wings and that they take their young as soon as hatch'd upon their backs & swim with them many fathoms out at sea." The Willock is the Puffin (*Fratercula arctica*), and, of course, the mode of incubating its egg here mentioned is mythical.

August 28 "Found a Tarrock dead on the shore at high-water-mark, one of the Phalaranopi [sic] observe the rudiment of a back toe, discript^{n} in Berkenhout very good, it may be call'd the Sea Ringdove." The "Tarrock" is a local name for the Kittiwake Gull, *Rissi tridactila*, which is distinguished from the other Gulls by the absence of, or the presence of only a very rudimentary hind-toe; it, of course, has no connection with the genus Phalaropus. Berkenhout was the author of a 'Natural History of Great Britain and Ireland,' published in 1769, which appears to have been esteemed in its day.

August 29 "Arthur Young call'd on me this morning. I learnt from him the name of my Grass, *Cynosurus cristatus*, which he spoke highly of. Sowed the Pightle this morning" He again records on the 29th of August, 1801, that he sowed seeds of *Cynosurus cristatus* in his pightle, just a year afterwards. Arthur Young was probably on one of his agricultural tours when he visited Dr. Sutton.

September 13 "W K & S K & Mrs & Miss & H Trimmer

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Found *Atroplex pedunculata*, *Ruppia marit* [*ima*] & *Lannich* [*ellia*] *palust* [*ris*]" The Ks here mentioned were doubtless the Kirbys, but who H. Trimmer was I cannot tell. Mr. Millard suggests that he may have been the elder brother of the Rev. Kirby Trimmer, late of St. George, Tombland, the botanist, who certainly had a brother Henry.

September 15th "Went to Heacham, Mr. N. Styleman observed the Swallows to have congregated that morn^{g} & covered the roof of a house there. H. Trim$^{r.}$ shot a *Larus canus* & *Nævius* and a Sterna with a Blackcap not mentioned in Berkenhout—neck breast & underpart of the wings white, head black, back & upper part of the wings ash colour, remiges black wth a broad white margin, rectrices white. 18 inches in length. 3 ft from wing to wing." Berkenhout, whom Dr. Sutton probably follows, applies the name *Larus nævius*, Lin., to a bird formerly known as the Wagel Gull; this name was probably used indiscriminately for the young of both the Herring and the Lesser Black-backed Gull, the immature forms of both these birds not having been recognised as such, but regarded as one distinct species. The Tern, I think, seems most likely to have been the Sandwich Tern, although the description does not quite agree with the plumage of that species—Berkenhout mentions only three species of Tern, the Common, Lesser, and Black Terns.

October 22. After mentioning a very high tide occurring at the high spring with a hard N.W. wind which, however, did little damage except to the Rabbits, 4 doz. and 11 of which were picked up drowned at the marsh gate near his house, he goes on to say: "A whale was cast ashore first at Thornham where they cut off its tail & one fin & the bacon off its sides, & made 15£ of the oil they sold at the rate of 5$^{d.}$ a pint. it floated afterwards & was cast on the bank of Mrs. Panton's fresh marsh, where I saw it, it appeared to have been 18 ft. long—a row of teeth in both jaws & a spout hole of the shape of a horse shoe at the back of the head the eye (I co^{d} see but one as it lay on its side) was small & very nearly on a line with the mouth—whether it had had a fin on the back, co^{d} not tell, the side fins were large boney & bent like elbows—it is the Delphinus orca Lin. anglice a Grampus." See also 14th August, 1801.

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1801.

Aug. 5. "Came to Holme."

7. "Found on the shore dead *Sygnanthus ophidion*, Tobacco-pipe fish or Sea Adder. On my return home cross the salt marsh I observed the Rabbits who had wandered from the warren into an enclosure surrounded wth a dyke contain^g^ water near 4 foot wide on the surface, leap over same back again with great agility as soon as they perceived me to approach."

"Note—Mr. Hurlock brought a marvellous story which he had heard at Mr. Wincops at Lynn respecting the growth of the *Vicia faba* wch he was told grew this year in the pod the contrary way, viz. with the hilum upwards, whereas it is said the hilum should be downwards or near the bean stalk so as the bean may project itself upwards—and this Mr. Whincop assures him he has undoubted evidence to prove was the case one year about a century ago after a year of scarcity like the present." A Rev. Wm. Milton Hurlock was Perpetual Curate of Hillington & from payments to "Mr. Hurlock" in an account-book marked "Holme" outside the cover it seems not unlikely that he acted as Curate for Dr. Sutton. His Bean story passes my understanding, the hilum seems to have been in the correct position.

Aug 14 "Ned Renant found on the beach a young Grampus, but just dead, it was about 8* feet long, & the teeth scarcely formed, most probably a sucking fish." I have the measurements of two very young examples of *Orca gladiator*, the dentition of which corresponded with the above description, which measured 7 ft. 6 in. and 7 ft. 5 in. respectively in a straight line; they were both taken in the month of November; the adult will reach a length of 21 feet.

Aug 17. "While at dinner wife & I perceived on the edge of the dish a curious insect which appeared to be of the Diptera Class if not of the Hymenoptera, but I co^d^ not perceive any shells to the 2 wings, it was about 4 lines in length, wth cheliform antennæ, the tips of wch were setaceous & divided into 2 segments with rings of white & brown, the thorax caput (head) & antennæ were brown, the eyes large and prominent, the wings upwards were semi-crustaceous & hairy, lower they were clear & transparent like

* The figure is doubtful, but I think it must be intended for an eight.

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those of the Neuroptera, the abdomen was of a burnished purple & a little hairy, the six legs were of a light green, there appeared to be two palpi proceeding from the under part of the head, also a light greene colour. It was very active & clapped together its two cheliform antennæ wth great briskness [added subsequently]. I sent the above insect to Mr. Marsham, who informed me it was the *Cimex spessicornis* a curious but not a very uncommon Insect of the hemiptera class." Mr. Thouless informs me that the above insect is now known by the name of *Heterotoma merioptera* and that it is a common species generally occurring on nettles; the Mr. Marsham referred to was Thomas Marsham, entomologist, Secretary to the Linnean Society from 1788 to 1798, he died in November 1819. Both Marsham & Sutton were original Associates of the Linn Soc. 1788.

August 19th "Rode in the afternoon to B [illegible]* thorp, observe the Gleaners in that & the large parish of Docking conveying home their burdens upon asses in large bundles suspended on each side of the Asses" (See 24th August).

— „ — 21st "Rode to Brancaster walked to the sea shore, found *Althea officinalis*, *Convolv*[*ulus*] *Sold*[*anella*] *Geran*[*Erodium?*] *cicut* [*arium*] wth very hairy stalks and leaves, hairs very long and white, petals white sometimes pink, ½ longer than calyx; *Silene marit*[*ima*], *Eryngium marit.* 2 species [?] of *Salsola*, *Beta marit.*, *Althea offic*in[*alis*]; gathered by the road-side *Marrub*[*ium*] *album* for Tom. Booker."

The following interesting note on the customs regulating gleaning, at that time a matter of great importance to the villagers with a view to their winter supply, is worthy of recording; it is an example of the unwritten laws which were strictly obeyed in many instances, such as marsh-mowing in the common lands in the Lincolnshire Fens, and the placing of eel-sets on our own rivers (See *ante*, vol. iv. p. 442).

August 24th. "Took tea at Thornham at Bentons It is worthy of remark the regularity wth wch gleaning is performed at Holme— here the Gleaners collect together at 8 O'Clock in the morning come home about 12—go out again after having dined & return again at 6 in the evening as regular as they went out. They may

* Probably Bagthorpe, he would pass through Docking on the way.

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go out of the Parish if the Farmers occupy land out of it, yet gleans is not an act wch the Poor may claim by common Law of the Land, the case was decided in one of the courts a few years ago when it was contended for on that ground, when the verdict given was that gleangs was only by sufferance, a good custom but still under restriction as seems fit & right it shd be. The women in general in this parish have gleaned this year 5 bushels each some small householders who keep a maid-servant send her out to glean & receive by contract one-half." The corn so gleaned was as a rule sent to the miller, and the grist went far towards supporting the family during the winter. The children became bread-winners at a very early age, and although individually small, the united earnings of the family, assisted by the garden produce and many a help from the farm-house, for these were patriarchal days, went further to supply their simple wants than perhaps we can now imagine. Their clothing was chosen for its durability, the expenditure on finery was *nil*, and many of the unmarried hands boarded in their masters' houses.

August 27 "Took an evens ride to Hunstanton & put the seeds of *Cineraria palust.* into the boggy ground under water at the pool near the Boat house at the turn of the corner on the left hand if you were [going ?] to the Boat" (a very reprehensible practice, Dr. Sutton.)

—„— 29th "Sowed seeds of *Cynosurus cristatus* in the Pightle."

Sept. 1 "Went to the Cliffs observd among the stupendous pieces of Rock which had fallen down, one which had the impression of a large *Cornu ammonis* [an Ammonite] upon it about 20 inches in diameter, it was upon the Calk [Chalk?] stratum I could not find the corresponding part."

Sep 2. Rain this morning after a drought of 5 weeks here (last Sumr there was a drought of 7 weeks) the rain however was trifling. Sowed seeds of *Poa pratensis* on the 3rd Septre."

Sept 4. "The rain now comes plentifully; the farmers say they never remembered so great & piercing a drought, some of the weather has been excessively hot & for a continuance. I observed the white-thorn fences in the new enclosures at Thornham (planted about 5 years) to have shed their parched leaves as tho' blighted, it was a singular sight in harvest time—some farmers were obliged to open their hay-stacks the pastures being quite sear."

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Sept. 7th. "Last night the rain was so violent & incessant as to have made great inundat^{ns} in Holme, our Cellar was filled wth water & the rump of beef with the tub of Pork were altogether overflowed—the Cottagers rec'd great damage by rain getting at their late gleanings & those farmers whose Barley stacks were not thatched must have suffer'd considerably as the rain was excessive, the wind was in the south east & it drifted the rain into the roofs of dwellings & pent-houses so that not a house in the village escaped being soaked. At Stanhoe the effect seems to have been the greatest, Mr. Wright had a great deal of his Barley car^{d} away in the swathe & Mr. Etheridge's beer vessels in his Cellar were actually rolled in the water & the beer spilled out of the bunghole."

"Speaking of Barometers the other day, Mr. Styleman said he remembered at Trinity College within side of the King's Gate, viz. next Trumpington Street there was one which worked wth water instead of Quicksilver & that it was 34 Feet long. Qu. if this was not erected by Roger Cotes? it must have been difficult to have procured a glass tube long enough to shew the variations. Ned Renant bro't us 6 Knots whose plumage is very handsome . . . the papers inform us that Mr. Ball of Lewis saw on the 4th of this month 4 or 500 on the wing and that he shot one wch was probably a male hav^{g} the breast red—ours was brown inclining to red."

I am sorry I cannot learn any particulars about the Water Barometer, formerly at Cambridge. Roger Cotes was the first Plumian Professor of Astronomy (1706) and he commenced building an Observatory over the King's Gate at Trinity College, but he died in 1716 before it was completed—it does not seem probable that so unwieldy an instrument would have been erected while the building was in an uncomplete state. Sir Isaac Newton's rooms were in the staircase next the gateway; he certainly contributed an astronomical clock to the Observatory, and possibly he may have had a hand in the construction of the Barometer after Cotes' death, this however is mere conjecture The Observatory was dismantled in 1797. Toricellis' first experiments were conducted by means of a water tube, but he speedily had recourse to mercury on account of its greater specific gravity, and although other liquids were experimented with, for many reasons they were soon discarded. The Royal Society's Water Barometer constructed by Daniell in 1830 was subsequently found to read seven inches of the water

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scale too low. It was afterwards reconstructed and removed to the Crystal Palace at Sydenham, where it was destroyed by fire. The most successful Barometer, in which a fluid other than mercury was used, was constructed by J. B. Jordan; it was filled with Glycerine, and from it the daily readings in the 'Times' newspaper are still, I believe, given.

1802.

9th July. "Arrived at Holme after having stay'd two days & 3 nights with Fawcett at Snoring." He gives a description of the Parsonage house, &c.

July 14 "Saw several Natter Jacks, both old & young ones, their colour brownish green, with darker tubercles, the tubercles of the old ones are tipp'd with red, eyes green with yellow irides, belly lighter coloured with black spots. Mem. they have claws both on their fore & hind feet, & they move rapidly setting out with first a hop & then a run. Also another species of Frog nondescript, olive green above, lighter underneath with no black spots, eyes green with red irides, nostrils very distinct, belly rather swelling—note—the common Frog is of a greenish-yellow colour, sometimes brown, a sharp nose with black moustaches, back narrow with ridges along the edges of it."

Dr. Sutton's "nondescript" Frog I am inclined to think was merely a variety of the common Frog, he does not seem to realise how greatly this species is given to vary; the absence of the "black moustaches" which he seems to imply, is perhaps the most unusual feature, for they are very constant.

Professor Bell (Brit. Reptiles, p. 100) calls attention to this tendency to variation in colour and marking in the whole family to which this species belongs, owing to variations of temperature, the intensity of light, the influence of fear or other "mental excitement," and Dr. Gadow (Camb. Nat. Hist. Amphibia, p. 252) is even more emphatic. Sutton does not state whether he observed more than one individual of this variety, and I do not think there is evidence to found a new species!

August 1. "Owing I suppose to the late continued rain the quickset fences in some instances brought forth blossoms a second time, especially on their eastern side."

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August 9th. "Whilst in the garden last night about 8 o'clock, I heard a sound in the air which was continued, & which seem'd to me like the buzz of Bees which had swarmed. The night was extremely calm & serene, I looked around but saw no Bees, at length looking up, I perceived a prodigious N° of Rooks high in the air, which were moving home to the Park at Hunstanton for the night, as they moved along their flight seem'd to be with labour as if fatigued with the exertion of the past day, & the beat of their wings against the air which was slow and gradual, resembled the beat of oars of expert Seamen who kept an equable slow time together."

This record of what was probably an early migratory arrival, one of those "rushes" with which we have become so familiar on the east coast, is the last entry in the Diary which concerns us as naturalists, there are various notes and rough pencil sketches of fonts, windows, armorial bearings, &c., in different parts of the County with which I doubt not, our archæological confrères are well acquainted, but here the regular entries cease. I must plead guilty to having been very discursive, perhaps unnecessarily so, in my endeavour to breathe life into the brief notes which the diary contains; but I trust my remarks may have rendered the somewhat dry bones of the entries not only more intelligible, but also may have in some degree developed the interest which their brevity and the lapse of time may have somewhat obscured.

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III.

DISTRIBUTION OF *PEUCEDANUM PALUSTRE* AND *LATHYRUS PALUSTRIS* IN BRITAIN.

By Arthur Bennett, F.L.S.

Read 28th October, 1902.

In the 'Norfolk and Norwich Transactions,' vol. vi. p. 457 (1899), and again in vol. vii. p. 333 (1902), I submitted to the Society some Notes on rare East Anglian Plants; and following these up I here give the distribution so far as known of the above two species.

I do so as a contribution to what I trust may some day appear, a Historical Record of the British Flora, tracing the species from their first records to the then time, with all their varying nomenclature, &c., under which they have appeared. It may seem needless to record all their localities, but if the rate at which some of our common species even are disappearing, it will not be so. Around this town (Croydon) Primroses are now rare, yet forty years ago thousands might have been gathered, and not been missed.

Peucedanum palustre. Moench. Methodus pl., Marburg, 82, 1794.

Thysselinum palustre (Tourn). Gray, Nat. Arrang. Brit. Plants, 518, 1821.

Selinum palustre. Linn. Sp. plant, ed. 1, p. 244, 1753.

In Ledebour's Flora Rossica, vol. ii. p. 310, 1844; 15 synonyms are given of this plant.

English names:—

Marsh Selinum. Huds. Fl. Ang., ed. 3, p. 115, 1798.

Marsh Milky Parsley. Relhan. Fl. Cantab. ed. 3, p. 115, 1820.

Marsh Milkweed. Withering Arrang., ed. 7, p. 2, 372, 1830.

Marsh Hog's Fennell. Hooker. Brit. Fl., ed. 1, p. 118, 1830.

Milk Parsley. Henslow and Skepper. Fl. Suff., 36, 1860.

Marsh Peucedan. Bentham. Hand. B. Fl. 255, 1858.

Water Parsnep. 'Tofield' ex Lees. Fl. W., Yorkshire, 260, 1888.

With regard to this last name in Dr. Prior's Pop. Names of Brit. Plants, 246, 1870; and in the Rev. K. Trimmer's Fl. Norfolk, this

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name is given to *Sium latifolium*, and to that species it seems generally to be applied in books; but in Eng. Bot. ed. 3, it is called Great Water-Parsnip, and *S. angustifolia* is called Water-Parsnip. In the Flora of Skipton (York.) this is called Broad-leaved Parsnep, and in the first issued Flora of the E. Riding of York it bears the same name.

In Europe, *Peucedanum palustre* is found in Sweden, Norway, Finland (22 districts), Denmark, Germany, Holland (23 stations), Belgium, Spain, France, Italy N., Austria, Poland, Hungary, Croatia, Banat, Transylvania, Serbia, Russia. Russian Asia.

In England :—

Somerset N. Co., 6.

On Cuckoo Bank, Glastonbury Moor. Sir T. G. Cullum, Bot. Guide, 521, 1805.

Burtle Moor!; Sole in Collinson's Hist. of Somerset.

Still in fair quantity on Shapwick Moor!

Murray, Fl. Som., 167, 1896.

Sussex E. Co., 14.

Near Hurstmonceaux, July, 1899. Messrs. Hilton and Druce ex Club. Rep. for 1899, 606 (1900).

Essex S. Co., 18.

Marshy place on the border of the Upper Forest (Epping), near the Windmill, and on the Epping side of Roydon in a sort of broad ditch. J. Ray. Gibson Fl. Essex, 129, 1862. Doubted by Watson, but Mr. Ray knew the plant well in Cambridgeshire.

Suffolk E. Co., 25.

Worlingham Common, by the side of the ditches, but sparingly. Rev. G. Crabbe, Bot. Guide, 544, 1805.

Blundeston. Wigg in Bot. Guide, 545, 1805.

Alder Cars at Fritton. D. Turner, *l.c.*

St. Olaves. Phyt, 370, 1862.

Marshes at N. Cove, Holmes; Barnby Broad, Leach in Hind's Fl. Suffolk, 175, 1889.

Belton Bog. Paget in herb., Watson!

Suffolk W. Co., 26.

College Plantation, and other plantations near Mildenhall. Sir C. J. F. Bunbury, in herb., Borrer!

Norfolk E. Co., 27.

Between Norwich and Heigham towards the river. Mr. Pitchford.

Alder Cars at Mautby, and in the range of marshes between

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Stalham and Ludham Bridge in immense quantity, and marsh adjoining Wayford Wood at Stalham! Mr. Wigg. Still there in some plenty, 1900.

Horning, near the Broad. D. Turner, Bot. Guide, 427.

Horning. Woodward Ann. Nat. History, vol. vii., 1841.

Ormesby! and Oby. Paget Hist. Yarmouth, 54, 1835.

Caistor and Ranworth! Winter Phyt., 227, 1862.

S. Walsham, Surlingham, Wroxham. K. Trimmer, Fl. Norf., 61, 1866.

Lessingham, Somerton, Horsey! H. T. Mennell, Trans. Norfolk and Norwich Nat. Soc. vol. iv. p. 256, 1886.

Hoveton Broad. Linton Journ. of Bot., 264, 1900.

Belaugh and Bridge Broads. C. E. Salmon, 1900.

Thurne, Martham, Whitesley, Blackfleet and Rollesby Broads. Salmon and Bennett.

Flegg Burgh, Filby, Acle, Brundall, Potter Heigham, Hickling. A. Bennett.

Norfolk W. Co., 28.

Forster's Alder Carr. E. Winch. Crowe in Hudson's Fl. Anglica MS.

Worthing,* Feltwell, K. Trimmer Supp. Fl. Norf., 23, 1884.

Shouldham Fen near Lynn. B. Bray.

Cambridge Co., 29.

Sides of drain running eastwards from Prickwillow, I. of Ely. Rev. Dr. Goodenough Bot. Guide, 49, 1805. Sp. from him in York Museum!

Anglesy Abbey. Henslow in Bab. Fl. Camb., 99, 1860.

Burwell Fen! 12, 8, 1835. Dr. Power. Borrer herb., 1838!

Wicken Fen. 1875 to 1883, plentiful! G. Goode, 1892! Reche Fen, Babington, *l.c.*

Huntingdon, Co., 31.

Banks of Whittlesea Mere. Sir J. Bank's Bot. Guide, 336, 1805.

It is evident from the observations of the Rev. E. C. F. Jenkins (Ent. Intel. 1859, p. 79) that in the Fens around Whittlesea Mere,

* Given as E. and W. by Trimmer, but falls wholly into Watson's W. and into Mr. Geldart's 'N.C.' in which he does not record it in Trans. Norfolk and Norwich Nat. Soc. 1874–5, or in the Victoria County History, but in the Trans. vol. iv. p. 719, 1889, he seems to have wholly referred Worthing to his S.C.

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Peucedanum must have abounded, as he speaks of the Swallow-tailed Butterfly (*Papilio machaon*) "might then be had to any amount" and its principal food-plant would be there also. The Butterfly there, as with the Large-Copper, is a thing of the past.

Mr. Fryer writes that he gathered it in "the bog in Holme Fen, Hunts, on September 17th, 1891, I think it was there some four or five years ago."

LINCOLN S. Co., 53.

Lees' Out. Fl. of Lin. in White's Directory, 14, 1892. "There is no record for S. Lincoln, but I have no doubt *P. palustre* was about Bourne and the Deepings in say 1800." A. Woodruffe-Peacock 14, 8, 1902. From the history of the land and old maps I have no doubt Mr. Peacock is right, in one of 1824, very wet land is shown from Bourne to Cowbit, south to Deeping and Gedney. Mr. H. C. Watson in Top. Botany gives S. and N. Lincoln, he seems to have been under the mistaken idea that the East Fen was in his V.C. of S. Lincoln, which certainly is not so. He makes the same mistake under *Senecio paludosus* and *palustris*; as Banks stations were certainly in N. Lincoln.

LINCOLN N. Co., 54.

In the East Fen in vast plenty, about the only umbelliferous plant that grows in the immense common meadows there. Sir J. Banks' Bot. Guide, 387, 1805. Long since extinct.

Sandtoft, 1879. Laughton Common, 1878. Rev. W. Fowler, Woodruffe-Peacock, 'Naturalist,' 341, 1894. In both places now (1902) verging on extinction. As it occurs near Wroot on the York side of the Toune Dyke (Lees' W. York, 260, 1888), it may occur on the Lincoln side as Wroot itself is in that County.

NOTTINGHAM Co., 56?

By the side of a small stream between Mansfield Wood House and Park Hill. New Bot. Guide, Supp., 644, 1837. No recent record.

It is probable the plant existed in the extreme N. of the County, in the area between Gringly, Misterton, and Finningley, as it did (or does?) exist in the adjacent parts of York and Lincoln. "I have no doubt it was in all three twenty-five years ago." Peacock in litt.

YORK S.E. Co., 61.

Beverley, 1796. Col. Machell in herb., Dalton.

York Phil. Society.

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At Weel Carr, and other places near Beverley. Sir T. Frankland in Smith Fl. Britt. 1, 303, 1800. Marshes near Beverley abundantly. Teesdale Bot. Guide, 679, 1805.

Extinct *fide*, Mr. Robinson's Fl. E. Riding of York, 116, 1902.

York S.W. Co., 63.

Whitgift. Rev. W. Wood. Smith Fl. Britt., 1, 303, 1800.

Potteric Carrs. E. Miller, 1804.

Marshes near Doncaster. Tofield in Hudson, 1762.

Low Moors between Goole and Thorne. Rev. W. Wood, Bot. Guide.

Thorne Moor. O. A. Moore in herb. York. Very abundant in July, 1845. O. A. Moore in herb. Watson! In 1844, Inchbald, 1872—1883. By the Toune Dyke near Wroot. Lees' Fl. W. York, 260, 1888. To the years 1840—50 it seems to have been tolerably plentiful, here and there abundant in Yorkshire, but gradually since has been getting scarcer year by year, and now verging on extinction.

59. Lancashire S.

"Southport, where I saw it still in 1870." F. A. Lees' Fl. W. York, 260, 1888.

69. (Lake Lancashire) Westmorland.

"Discovered in 1779 or 1780 by Mr. Seatle at Canon Winder, near Flackburgh in the ditches, on the sand side not very plentiful, and I have since found it round the side of Ayside Tarn, three miles N. of Cartmell, Mr. Hall." With. Arrang. Brit. Plants, ed. 7, vol ii. p. 372, 1830.

In a ditch on the right hand side, in a level field below Witheslode" Winsor (Dr. Windsor?) M.S. in Townsend's copy of Bot. Guide, 1805. Lees' Fl. York, 260, 1888.

Between Ambleside and Kendal. Mr. Jackson Bot. Guide, 641, 1805.

Specimen from the first named station in Herb. Winch at Linnean Society! See 'Naturalist,' 267, 1901, and 368, 1901, as to names, &c. Sought lately by Mr. Petty, without success.

Other counties reputed but not confirmed :—

24. Berks. Druce J. of Botany, 308, 1901.

Flora Berks, 249, 1897. Planted?

36. Hereford. About the Malvern Hills. Dunscomb, an error. Fl. Hereford, 151, 1889.

76. Renfrew, I have no information as to this county.

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83. EDINBURGH. Marsh near Colinton, G. Don. Greville Fl. Edinb., 64, 1824.

99. DUMBARTON.

In a ditch, Ardencaple Wood. Hopkirk Fl. Glottiana, 1813. First record in England.

"*S. palustre* . . . in *Salubibus* proper Doncaster. D. Tofield. Hudson Fl. Angl., 115, 1778." Clarke First Records Brit. Plants, ed. ii. p. 65, 1900.

From the above records it will be seen the head-quarters of this species in England is Norfolk; no less than thirty-three stations being now on record. This is quite as much so as to stations, as to numbers of specimens. The only county at the present time in which it exists in any quantity outside Norfolk is Suffolk. And I have little doubt that these numbers in Norfolk would be largely increased if looked for; wherever I have searched marshy ground I have found it, though sometimes in very small quantity. Mr. Winter (Phyt. 227, 1863) speaks of its abundance at Ranworth by saying "One might gather waggon-loads of it." I have never seen it in such quantities as this would imply, but it is abundant at Rollesby Broad. The finest specimens I have seen were at a dyke-side in Filby Broad, and were six feet high, with branches in proportion, and fine umbels.

There is however no doubt that before the systematic drainage of the Fens, Marshes, Carrs, &c. began, it was plentiful in many counties, but until Mr. H. C. Watson began his series of works (1832), little trouble was taken to record localities in any systematic manner, hence our records are very meagre, though I believe that closer searching among old books and herberia might afford more data that at present we possess. The Caterpillar of the Swallow-tailed Butterfly not only feeds on this plant, but also on *Angelica sylvestris*, as I observed it doing so in 1900, at Thurne and Ranworth.

LATHYRUS PALUSTRIS, Linn.; Sp. Plant, vol. ii. p. 733, 1753.

English Names.

MARSH LATHYRUS. Hudson's Fl. Ang., ed. 3, 317, 1798.

BLUE MARSH VETCHLING. J. E. Smith, Eng. Fl., ed. 2, v. 3, p. 278, 1829.

CHICKLING VETCH. Withering, An. Brit. Pl. ed. 7, v. 3, p. 840, 1830.

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Marsh Pea. Bentham, Hand. Brit. Fl., 182, 1858.

Duckling Vetch, Marsh Vetchling. Townsend, Fl. Hants, 97, 1883.

Distribution :—

Norway, Sweden, Finland, Denmark, Germany, Holland, Belgium, France, Spain, Portugal, Italy, Switzerland, Austria, Russia.

Russian Asia. North America, Labrador to Alaska; Mass, U.S.A. to Dakota.

In England.

6. Somerset N.

Near Burtle, eastern side of Calcott Drove, and on the N. side of the Bure. T. Clarke, sp. about 1850. Still plentiful by Calcott Drive. Murray, Fl. Som., 93, 1896.

Burtle Turf Moor. J. C. Collins' New Bot. Guide, 556, 1837

Shapwick Moor. H. Fisher, 1883. York Herb!

11. Hants S.

Botany Bay. Notcutt, Phyt. 1, 328, 1842. Not seen of late years.

17. Surrey.

Peckham Fields in a squalid watery place. T. Willeslel. Sp. in herb. Sherard at Oxford!

25. Suffolk E.

Burgh Castle Marshes, Herb. Buddle, circa., 1698. Phyt., 362, 1862. I failed to find it in 1877. Beccles and Worlingham Fens, D. Turner's Bot. Guide, 559, 1805.

Belton Bog. Paget's Hist. Yarm. 1835. Woodward 1840 in herb. Watson!

Carlton Colville. Herb., Skepper.

Flixton. L. Wigg, Bot. Guide, *l.c.*

Oulton Marshes, directly S. of the Broad. Henslow and Skepper, Fl. Suff., 24, 1860.

Roos Hall Marshes, Leach. Marshes at N. Cove and Barnby Holmes in Hind's Fl. Suff., 123, 1889.

26. Suffolk W.

Lakenheath. F. R. Eagle in herb. Miss Lathbury. Tuddenham. Herb., Wilson. Hind, *l.c.*

27. Norfolk E.

Near Ranaugh (Ranworth), Humphrey. Smith in Fl. Britt., 2, 767, 1800. A. Bennett, 1901. D. Turner in Herb. Brit. Museum! Near Yarmouth. Winch, herb!

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Ormesby Broad. H. G. Glasspoole!

Surlingham, Potter Heigham (1883!), Hoveton St. John, Buckenham, Strumpshaw. K. Trimmer, Fl. Norf., 43, 1866.

S. Walsham, 1876; Ludham, 1880. Trimmer Supp., 19, 1884.

Marshes at Hickling. L. Wigg, Bot. Guide, 440, 1805. Mr. Geldart recently.

Marshes at Horning. R. Wigham, Bot. Guide, *l.c.*

Abundant between Ranworth Dyke and Horning Church, right hand of the river. C. E. Salmon, 1902.

Acle near the Station, 1883. A. Bennett.

Caistor, Aldby, Lopham, Loddon-Norton, Kirby-Cane, Bressingham near Thetford. Winter in Phyt., 227, 1862.

Wroxham, abundant; Mennell, Salmon, 1900.

Marsh near Rockland Broad. Nicholson, 1902.

28. NORFOLK W.

N. Wootton. Dr. Lowe ex Geldart.

Against Euston Bridge near Thetford, Norfolk, 1836. Herb. Salmon, Norwich ex Linton.

29. CAMBRIDGE.

Burwell Fen. Dr. Power, 1833. Borrer, herb., 1838. G. S. Gibson, 1848, Phyt. vol. iii., 310, 1848.

Wicken Fen. Babington, 1851. A. Bennett, 1870. Still plentiful there.

Anglesey Abbey. Henslow. Bab. Fl. Camb., 65, 1860.

Reche Load, before the Cut divides; Swaffham Fen; Little Eversden. Relhan Fl. Cant., 293, 1820.

31. HUNTS.

Whittlesea, 21, 7, 1837. J. A. Power!

Yaxley and Stilton Fens! 1840. Bree in Phyt. 4, 103, 1851.

Monk's Wood. Syme in Eng. Bot., ed. 3. vol. iii., p. 108, 1864.

37. WORCESTER.

Longdon Marshes, near Upton-on-Severn. E. Lees, Phyt., 4, 799, 1853; 113, 1855.

41. GLAMORGAN.

Llanrhidian, Mt. Eve. C. Crouch, J. of Botany, 251, 1891.

48. MERIONETH.

Margin of Bala Lake. J. C. Bowman in New Bot. Guide, 224, 1835.

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49. CARNARVON.

Wet field near Little Ormes Head, 1831. Dr. Howitt!

Plentiful in a field between the two Ormes Heads, July, 1836. Babington! Journal, 50, 1897.

Gloddoeth. R. Crutch, sp. 1840. Extinct. Griffiths in litt.

53. LINCOLN S.? Top. Bot.

No record in Lees' Outline Flora, or Peacock's Lincoln List in 'Naturalist.'

54. LINCOLN N.

In the meadows in the E. Fen in abundance, when they are liable to be overflowed. Sir J. Banks, Bot. Guide, 390, 1805.

Grainthorpe, 6, 1857. Messrs. Bogg & Lees, *l.c.*

Near Lincoln, 1891, J. S. Smith. Peacock in 'Naturalist,' 219, 1894.

61. YORK S.E.

Near Hull. P. W. Watson, Bot. Guide, 705, 1805.

Marshes near Beverley, abundantly. Teesdale, 1796. Sp. in York Herb!

Heslington Fields. Middleton, sp., 1830.

H. T. Mennell, 1851. Extinct here.

Near Arram, 7, 7, 1890. J. F. Robinson, sp.

63. YORK S.W.

Marsh below Brampton. G. E. Smith, 1845. Border of Thorne Moor, 1872. F. A. Lees' Fl. W. York, 203, 1888.

64. YORK M.W.

Ascham Bogs near York. H. Ibbotson, 1830, in York Herb.

74. WIGTON?

Galloway. Mr. Mackay. Hook. Brit. Fl., ed. 3, 324, 1835; never confirmed. See Ann. Scott Nat. Hist., 247, 1896; 51, 1897.

The following Counties have been reported, but no recent confirmation seems to have been made:—

12. HANTS N.

"In the low meadows near Stoke Common, near Bishopstoke, collected by Dr. Garnier, Dean of Winchester," Dr. Bromfield in Watson's Cyl. Brit. vol. iii. p. 414, 1852. The species so named in Herb. Reeves, from "Herb. the very Rev. the Dean Bishopstoke, August, 1839, in the narrow-leaved form of *Lathyrus montanus*. Townsend, Fl. Hants., 97, 1883.

22. BERKS. See Druce Fl. Bot. 157, 1897.

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55. LEICESTER.

Bogs in Charnley Forest, near Bardon Hill. Dr. Pulteney, 1759 Retained as having formerly occurred in the Fl. of Leic., 44, 1886, with the note "this is now extinct."

57. DERBY.

Pinxton. Mr. Coke in Pilkington's History, Bot. Guide, 190, 1805. No further information in Rev. Painter's Fl. D., p. 40, 1889.

58. CHESTER.

A sp. labelled from Cheshire in the handwriting of (and given to Lord de Tably) Rev. A. Bloxam; Fl. Cheshire, 91, 1889.

69. L. LANCASHIRE.

Hudson's "passim" may have covered this part of Lancashire.

IRELAND.

Counties of Galway, King's Co., Wicklow, Meath, Westmeath, Longford, Roscommon, Cavan, Fermanagh, Tyrone extinct, Armagh, Antrim extinct in 1840.

Cyl. Hib., ed. 2, 94, 1898; Praeger Irh. Top. Bot., 92, 1901; Irh. Nat., 184, 1902.

First record in Britain.

"Lathyrus flore ex cœrulea et rubro mixto." In a wet marsh on the left hand of Peckham Fields from London. Merrett Pin. Rer. Nat. Brit., 70, 1666. W. A. Clarke. First record of Brit. Pl., ed. 2, 43, 1900.

In various parts the sp. varies. The var. *myrtifolius*, Gray (*L. myrtifolius*, Muhl) is a broad-leaved form of the plant; the only specimen approaching this from England is one from the Rev. W. Peacock, from "near Lincoln," this might perhaps have been a casual (Nat., 220, 1894). The var. *linearifolius*, Ser. in Dd. Proc., 271, 1825 – *v. tenuifolius*, Meyer Ch. Hann., 148, 1836, which I suppose is the same as *L. vicaiæfolius*, Wallr., Sch. crit., 388, 1822 (this was founded on a single sp.) can be matched among English specimens.

This sp. may yet occur in Scotland, as it extends to 70° 27′ N. Lat. in Norway (Norman Norg. Art. Fl., 216, 1895); and in Finland to 69° N. Lat. (Mus. Fl. Fenn, 79, 1889).

The next two species I hope to mention, are *Carex paradoxa* and *Lastrea cristata*, for any notes on either, I shall be greatly obliged.

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IV.

EAST ANGLIAN GEOLOGY—HISTORICAL SKETCH. DAWN OF THE SCIENCE OF GEOLOGY.

By Henry Woodward, LL.D., F.R.S., F.G.S., F.Z.S.,
President, N. & N. Nat. Soc.

Read 25th November, 1902.

The Eastern Counties appear to me to offer a favourable country for the manufacture of good home-made geologists, and I am convinced that the subsoil is accountable for the circumstance. Indeed it is an interesting fact, that wherever scientific observers have arisen in the old days, before geology became established as one of the natural sciences, such observers were first led to reflect by noticing around them the presence of fossil shells and other marine organisms scattered over the surface, often on high elevations far removed inland away from the present sea-margin, as they may frequently be seen in Norfolk and Suffolk to-day. But even men of intelligence do not view the phenomena of nature from the same stand-point, and thus it happens that whilst a few able men in the early days convinced themselves that such remains indicated the former presence of the sea over those lands, the larger number accounted for them by saying that such bodies were *lusus naturæ*, and had never been alive—or that they were incontrovertible evidence of the Noachian Deluge.

In Italy, one of the earliest intelligent observers was Steno, a Dane, Professor of Anatomy at Padua, who in 1669 dissected a recent Shark, and showed that its teeth were like those of the fossil Sharks found on the Tuscan hills, and that the fossil shells found there resembled those living in the adjacent sea.

Another early writer suggested that the extinct bivalve shells known as *Pecten jacobæus* found on the Tuscan hills, were dropped

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by pilgrims (who wore this badge) on their way to Rome: thus the poet writes:—

> "The pilgrim's staff and scrip he bore,
> And placed the cockle in his hat before."

GESNER, a botanist of Zurich, adopted in 1759 the same views as Steno, and showed that as many changes of land and sea had taken place, and that by slow degrees, occupying thousands of years in their accomplishment, such fossils could not possibly be referable to the Noachian Deluge; the animals and shells having lived upon the spots where they were discovered.

Although many great names may be cited as having published learned works, a few in favour of natural causes, but many more advocating fantastic explanations to account for geological phenomena, it was not until the days of WILLIAM SMITH (1769—1839), that a real and solid advance was made towards the establishing of geology on a sure foundation.

WILLIAM SMITH, LL.D. (born 1769, died 1839, aged 70 years). Though only a poor lad, brought up at Churchill, a village in Oxfordshire, Smith early displayed a keen power of observation, and a habit of collecting fossils; in time he became a land surveyor. Whilst thus employed he discovered that the strata composing the country followed each other in a regular and orderly succession, each bed being characterised by its own particular fossils, and having a general tendency or "dip" to the south-east. In the course of his work he produced (in 1815) a Geological Map of England and Wales on which he laid down the main lines of the various formations, which (with slight modifications) remain the same to the present day, showing the patient and exhaustive manner in which his task was performed.

As a geologist of the highest eminence, and a teacher, the name of PROFESSOR SEDGWICK (1784—1873) must always rank in the first place. He was a fellow of Trinity College in 1810, and succeeded Professor Hailstone in the chair of geology at Cambridge in 1818. This chair (founded by Dr. John Woodward) was originally designed by him to maintain the doctrine "that all fossils were the result of a universal deluge which had once swept over the whole earth, and to the agency of which, by gravitation, all the strata

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owed their origin!" Also to oppose the views of a certain Dr. Camerarius of Tubïgen, who disagreed with him!

Sedgwick was the first Professor who delivered regular courses of lectures based on sound geological views, and upon the orderly succession of the rocks and their identification by fossil contents, as enunciated by William Smith. Like the late Sir Roderick Murchison, Sedgwick worked and wrote principally on the older Palæozoic rocks of England and Wales, yet he contributed to the geology of the neighbourhood of Cambridge, including the formations between the Chalk and the great Bedford level; and he turned out a large number of men who, like himself, became eminent and enthusiastic geologists,* many of whose names are the glory of English Geology.

Among East Anglian Geologists the name of SAMUEL WOODWARD (1790—1837) of Norwich deserves a place. At an early age he commenced to make careful observations, collect fossils, and to study the works of Parkinson, William Smith, Conybeare, and Phillips, whilst the discovery of fossil bones on the coast of East Suffolk by Richard Taylor in 1822, induced him to make further researches at Cromer and Happisburgh, and ultimately to prepare and publish his "Outlines of the Geology of the County of Norfolk," which appeared in 1833, and "Some Remarks on the Crag formation of Norfolk," in 1835 (Phil. Mag.). He also prepared a "Synoptical Table of British Organic Remains," issued in 1830, which was the basis of Prof. Morris's Catalogue of British Fossils.

Three sons and four grandsons of Samuel Woodward of Norwich have all pursued scientific careers.

B. B. WOODWARD, F.S.A. (formerly the Queen's Librarian), born in Norwich, 1816, died 1869. In his early days wrote upon geology and edited his father's works.

SAMUEL P. WOODWARD, F.G.S., born 1821, died 1865, sometime Professor of Geology in the Royal Agricultural College, Cirencester, was afterward for seventeen years assistant in the Geological Department of the British Museum. He wrote several articles on

* Sedgwick did great honour to William Smith, and when President of the Geological Society, he presented (in 1831) the first Wollaston Medal to Smith, and styled him in his address, "the Father of English Geology," a title which we still desire to see associated with his name.

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the Geology of Norfolk, and upon Chalk and Crag Fossils. His Manual of Recent and Fossil Shells attained to a sale of more than 11,000 copies. He was followed by his youngest brother, DR. HENRY WOODWARD, F.R.S., President of the Geological Society of London in 1894—96, who has lately completed forty-three years' service in the same department, of which he was for a long time the Keeper; he has also edited the Geological Magazine for thirty-nine years.

B. B. WOODWARD, F.L.S., F.G.S. (British Museum, N. H.), son of the late Queen's Librarian, has contributed various papers on Pleistocene Land and Freshwater Mollusca, and has edited the Proceedings of the Malacological Society of London, 1893–1903, of which Society he was one of the founders.

B. H. WOODWARD, F.G.S. (son of S. P. Woodward), is now Director of the Perth Museum, Western Australia. His younger brother, HORACE B. WOODWARD, F.R.S., F.G.S., is well known to the members as a past-President of this Society, and is now Assistant-Director of the Geological Survey of England and Wales H. P. WOODWARD, F.G.S., Assoc. Memb. Inst. C.E. (son of Henry Woodward), is Hon. Consulting Geologist and Mining Engineer to the Colony of Western Australia, and actively engaged in Mining Geology. A fifth grandson, MARTIN F. WOODWARD, (Hon. Sec. Malacological Society, and Demonstrator in Biology in the Royal College of Science), was lost to the world a year ago, after a brief but brilliant career, being unfortunately drowned at Moyard, Connemara, in September, 1901.

SIR JOSEPH PRESTWICH, D.C.L., F.R.S. (born 12th March, 1812, died 23rd June, 1896), some time Professor at Oxford, took a deep interest in the geology of the Eastern Counties, and together with Charlesworth and Searles Wood worked assiduously at the Geology of the Crag. We owe to Prestwich a comparison of the Suffolk Crag, with the Antwerp and other Belgian Crag deposits of a similar age. He wrote papers also upon the Drift deposits of Suffolk and those of the Norfolk Coast.

Another eminent geologist (still surviving and now in his 85th year), is the REV. OSMOND FISHER, M.A., F.G.S. (born 1817), of Harlton near Cambridge, who has written on the "Warp and Trail" of Trimmer, studied the Mammalia of the Peat-deposit at Lexden,

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in Essex, and described the geology of the Coast of Norfolk. He is also a great Mathematician and has spent years in calculating the age of the earth, and in investigating the causes of earth-movements and the elevation of mountains.

Searles V. Wood, F.G.S. (born February 14th, 1798, died October 26th, 1880). It is interesting to mention that *the first volume* contributed to the Palæontographical Society of London was prepared by the late Searles V. Wood, F.G.S., and describes the fossil Mollusca of the Crag formation. This work (which extended from 1848 to 61, with supplements, 1871, 73, and 79), is illustrated by 71 quarto plates, and contains in addition to the shells, a geological description of the Crag formation, by S. V. Wood, Jun., F.G.S., and F. W. Harmer, F.G.S. (1871—73).

Searles V. Wood, Jun., F.G.S., born 1830, died 1884. Mr. F. W. Harmer, who delights to call himself "the pupil of S. V. Wood, Jun.," and was for many years his friend and coadjutor, thus writes in appreciation of his "dear old Master": "The distinguished son of a distinguished father, the name of Searles Valentine Wood, the younger, must be placed in the front rank of East Anglian Geologists. It is difficult for us now to realise the position of the Glaciology of the East of England when Wood entered on its study. No map of the drift beds was in existence, nor had any attempt been made to produce one. Wood saw, however, that until this was done, no further progress was possible, and he set before himself the great task of surveying the whole of the eastern part of England, from the Humber to the English Channel, and from the shores of the North Sea to the Midlands. Worn out by his incessant labours, but not before his task had been fulfilled, he died, alas, comparatively young, a martyr to science—too soon for his own reputation, for his friends, and for the interests of geological investigation. He has left behind him an imperishable record in glacial literature, *ære perennius*, and has earned the undying gratitude of all students of the subject."

Mr. F. W. Harmer, F.G.S., has devoted many years (at first in association with Mr. S. V. Wood, Jun.) in working out the Geology of the Crag and Glacial deposits of East Anglia. After the death of his friend he continued the work alone, and indeed has never abandoned the subject, having, during the last ten years, contributed

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a number of important papers thereon to the Geological Society of London, and to other Scientific Societies.

In February last (when presenting Mr. Harmer with the Murchison Medal of the Society), the President (Mr. J. J. H. Teall, F.R.S.) said to him: "In speaking of your earlier work, it is impossible to separate your name from that of Searles V. Wood, Jun., who, I believe, *discovered* you on the Cromer Coast, nearly forty years ago, when you were trying to solve the riddle of its complicated drifts. Wood, who had previously made a Drift Survey of the whole of Essex, on the scale of one inch to the mile, soon enlisted your services in Norfolk, while he continued his work in Suffolk; and in the course of about four years, you were together able to bring before the British Association at Norwich, a summary of the results at which you had arrived from the mapping of the Crag and Glacial beds. Your map was published by the Palæontographical Society in 1872, with a memoir elaborating many points touched upon in your previous work. These original surveys formed an excellent basis for your further researches into *the structure and method of formation of these deposits, and for the labours of all who have followed in your footsteps.* Freed from the cares of business and municipal duties, which occupied much of your time in earlier years, your attention has latterly been given to a study of the minuter divisions of the Crag series, not only in England, but abroad—in Holland, Belgium, etc.; thereby dealing with the zonal succession in the Crag series, and with the distribution of molluscan life generally in the Pliocene period, you have enlarged our knowledge of the physical and climatal conditions under which both Pliocene and Pleistocene deposits were laid down, and have drawn especial attention to the way in which Meteorology can aid in the solution of Geological problems." [Quart. Journ. Geol. Soc., London, 1902].

Another Norfolk worthy must be specially mentioned, viz., JOHN GUNN, F.G.S. (born 9th October, 1801, died 28th May, 1890). He was a Norfolk geologist of repute, and for many years held the living of Irstead and Barton, but resigned in 1869, and devoted his time wholly to geology. His investigation of the remarkable Forest-bed on the Norfolk Coast occupied the greater part of his long life, and the collection in the Norwich Castle-

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Museum of the Mammalia obtained by him from that deposit testifies to his earnest and untiring work.

He wrote a paper, read before the Geological Society of London in 1870, on the position of the Forest-Bed and the Chillesford Clay in Norfolk and Suffolk, and on the real position of the Forest-Bed; and a second paper on the Forest-Bed at Kessingland and Pakefield in 1876. After his death a memoir on the same subject was published, partly written by him, and edited by Horace B. Woodward, F.R.S., with descriptions of the fossils by E. T. Newton, F.R.S., and several plates. He was President of the Norwich Geological Society for fourteen years, viz., from its foundation to 1878, and was the author of a well-known article on the Geology of the district in White's 'History of Norfolk.'

The Geological Survey in the Eastern Counties has been represented by Mr. William Whitaker, B.A., F.R.S., F.G.S., who has worked for many years upon the geology of the Chalk and the Lower Tertiaries, the Red Chalk of Hunstanton, on Subaerial Denudation, and on that most important question, water supply. He was engaged for about eight years on the geology of the Eastern Counties, and will be remembered no doubt by many.*

No record of the Crag formation would be complete without a reference to Edward Charlesworth (born 13th September, 1813, died 28th July, 1893). He was an F.G.S. from 1835, and was at one time employed in the British Museum, and as the editor of 'Loudon's Magazine of Natural History.' He was also Honorary Curator of the Ipswich Museum, where some of his early collections of Crag fossils are still preserved. After his return from a trip to South America in 1840, he gave up other work and devoted himself to collecting in the Eocene Tertiaries, and in the Crag. He also wrote a paper on the Sperm-whale (*Physeter*) from the Red Crag of Felixstowe. In 1844 he was appointed to succeed Professor Phillips as Curator of the York Museum, where he continued till 1858, when he resigned and returned to London. He spent much time collecting fossils, and never to the end lost his love for the Crag formation.

* The geological survey of Norfolk and part of Suffolk was carried on by Mr. Horace B. Woodward, F.R.S., Mr. Clement Reid, F.R.S., Mr. J. H. Blake, F.G.S., and others.

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DR. JOHN ELLOR TAYLOR, F.L.S., F.G.S. (born September 21st, 1835, died September 28th, 1895), an enthusiastic lover of Nature; was connected with the press in Manchester and Norwich, and in 1872 was appointed Curator of the Ipswich Museum. All his leisure hours were devoted to Geology, and he was the means, both in Norwich and Ipswich, by his lectures and writings, of stirring up people to take an interest in the geology of their own neighbourhood; he also made many excellent observations on the Chalk and Crag deposits. For many years he edited 'Science Gossip,' but his health failing he retired from that position. His last appearance was at the British Association Meeting in Ipswich, in September, 1895, when he spoke on the Stutton boring.

THE "VALHALLA."

King Louis of Bavaria conceived the idea of erecting a "Valhalla," or Temple of Fame, consecrated to men who had become renowned in war, statesmanship, literature, science, and art.

This remarkable building stands at Ratisbon, on the Danube. On one occasion King Louis took our countryman Sir Roderick I. Murchison (the celebrated geologist) and showed him that the name of Murchison had been inscribed upon one of the tablets, although he was an Englishman. The British Museum (Natural History) in Cromwell Road is gradually assuming the character of a "Valhalla," having Statues of Sir Joseph Banks, Darwin, Owen, Huxley, busts of William Smith, Gray, Falconer, and Bowerbank, and portraits of Agassiz, Egerton, Enniskillen, and others. The bust of Sir William Flower is about to be added to the collection.

In the Blackmore Museum at Salisbury the plan has been adopted of inscribing the names of men of science on the walls above the cases.

I would suggest that the names and dates of donors to the Norwich Castle Museum, and those of workers in Geology and other branches of Natural History, or in Archæology, might similarly be inscribed on the walls of the several Galleries, "as a memorial to them that shall come after."

Your list of *Norfolk worthies* is great and so also is the list of those who have wrought in the geology of East Anglia and it deserves to be perpetuated.

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General Geological Features.

A glance at a geologically coloured map of the British Isles reveals to the observer the fact that the strata are so arranged in chronological sequence across the country from west to east, that if a straight line were drawn down the map from the Tees to the Solent, all the older sedimentary rocks would be found cropping up to the West of that line, and *nearly all* the younger ones to the East of it.

Of these younger deposits the kingdom of East Anglia is chiefly built; nevertheless, considerations of relative geological antiquity need not trouble us, seeing that even the youngest of these strata is so immeasurably older than the whole period of time over which human records extend, that we can afford to dismiss the question of years in geology, as trivial and out of place.

What then are the deposits which make up our native counties? for, as a Norfolk man, I may claim a close interest in and attachment to everything appertaining to East Anglia and its environments.

The Great Chalk Formation.

Although the solid geology of East Anglia is, superficially, very largely masked by deposits of *Boulder-clay*, yet the backbone of the district is the great *Chalk Formation*, extending from Flamboro' Head in Yorkshire, through Lincolnshire, Norfolk, Cambridgeshire, Suffolk, Herts, Berks, Wilts, Hants, and Dorset, down to the Sea at Beer Head in Devon, and forming the bulk of the Isle of Wight and the counties of Kent and Sussex.

The Chalk is a great marine deposit and attains a thickness of over 1,000 feet (at Carrow, Norwich 1,152 feet and 1,187 at Mousehold). It is like a white limestone, not thoroughly solidified—but *some parts* of the lower Chalk known as Hard Chalk are employed for Building-stone as at Beer in Devonshire, in Lincolnshire (Louth Abbey), and in *West Norfolk*.

It is almost wholly composed of pure carbonate of lime. But throughout the greater part of the Chalk there occur nodules of black flint, and grey flint, *usually in bands, that coincide* with the stratification *or layers of deposit* of the materials composing it. Where the Chalk is destitute of layers of flints, it is found to

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contain over 21 per cent. of silica, so that it is now generally concluded that the flint has segregated out of the Chalk and formed into concretionary nodules, much in the same way as iron-pyrites forms into nodules or concretions in the Gray Chalk and the Gault-clay, and in which "*Septaria*" (which are nothing more than concretions) are formed in layers in the London Clay.

Large pear-shaped or cylindrical flints of great size, with a cavity through the centre (called by Dr. Buckland "Paramoudra," a name given to similar large flints in the Chalk of Antrim and Co. Down, Ireland), occur singly in many localities in the Chalk and in some places forming more or less regular columns, the pot-stones resting one upon another as in the Chalk at Trowse and Whitlingham, and at Horstead on the river Bure in Norfolk. They are no doubt due originally to the dissolving up and the redeposition of the siliceous spicules of Chalk sponges which must have flourished to an enormous extent in the sea of the Chalk-period, as their remains are very numerous in some beds, although the spicules of flint are often destroyed or converted into an almost amorphous mass of flint. From the nature of the materials forming the Chalk, as well as the organic remains which occur in it, the Chalk is considered to have been formed in a deep and open sea; indeed recent researches carried on in the North Atlantic Ocean show that material for a continuous calcareous deposit with flint-nodules is now being deposited at depths of from 400 to 2,000 fathoms, while many forms of microscopic animal life such as *Globigerina*, and Coccoliths and Coccospheres occur in equal abundance in both the modern marine deposit and the ancient Chalk.

What does the Chalk rest upon?

Coal-boring in the Eastern Counties.

I have said that the oldest formation cropping out at the surface in East Anglia is the Cretaceous, this term including the "Red Chalk" of Hunstanton, the "Carstone" of West Norfolk, the Cambridge Greensand, and the Gault-clay. Until 1854, when the Harwich well-boring was carried to a depth of 1098 feet, the base of the Chalk had never been reached in this neighbourhood, although 500 well-borings have been made within the last twenty years.

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The greatest depth of a well at Norwich appears to be that at the workhouse which did not exceed 360 feet.

At Harwich (Essex), a boring passed through the following strata :—

	Thickness.	
Drift London Clay and Reading Beds	69 feet.	
Chalk	890 „	
Gault	70 „	
		1029
Palæozoic Rocks	69 „	

At a depth of 1029 feet the borer entered a slaty rock which it penetrated for 69 feet, when the boring was terminated.*

Professor Prestwich assumed that this slaty rock was of Carboniferous age, on account of the supposed presence of *Posidonomya*. But the organic nature of this fossil has been doubted by Mr. Etheridge, F.R.S., and Professor W. W. Watts, who recently examined it.

Professor Watts has detected an *Orthoceras* in the same rock from the *Stutton* boring.

Culford Boring, *near Bury St. Edmunds.*

A Boring was undertaken in 1890—91, north of Culford Park, five miles N.N.W. of Bury St. Edmunds, to obtain water for new buildings on Earl Cadogan's estate. The bore-hole yielded the following particulars :—

	ft.	in.
Soil, &c.	6	0
Chalk	526	0
Gault	73	0
Lower Greensand	32	6
Palæozoic Slaty Rocks ...	19	9
	657	3

Messrs Whitaker and Jukes-Browne say—"there is only one point on which all are agreed, namely, that these Culford Slates are *older* than the Coal-Measures."†

Stutton Boring.

On the Northern side of the estuary of the Stour the Eastern

* [Annual Report of the Geol. Survey for 1896].

† Quart. Journ. Geol. Soc. vol. 50, p. 495.

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Counties Coal-boring Association put down a trial boring at Stutton, which gave the following section viz:—

	ft.	in.
River Gravel	16	0
London Clay and Reading Beds ...	54	0
Chalk	874	6
Gault	49	6
	994 feet.	

The greatest known thickness of Cretaceous Rocks in Suffolk, viz., 924 feet, was found here.

Palæozoic rocks were reached at depth of 994 feet, these were penetrated to a depth of 531 feet. The bore was carried down to a depth of 1525 feet. The consulting Geologist and the Mining Engineer-expert are agreed that the rocks reached are older than the Coal-measures (Geol. Mag. 1896, p. 95).

The old rocks reached are represented by a slaty rock, possibly Silurian, possibly Cambrian, but no fossils have been observed in the cores (an *Orthoceras* has since been found in one of the cores by Professor W. W. Watts).

Prospects of finding Coal under East Anglia.

On the probable discovery of Coal. The finding of rocks, older than the Coal-measures at Culford, Stutton, and Harwich, does not demonstrate that Coal-measures cannot be found under the Eastern Counties, for it should be borne in mind that not far from the very ancient rocks of Charnwood Forest the Leicestershire Coal-field occurs; and again quite close to the old Cambrian rocks of Nuneaton we find the productive Warwickshire Coal-field.

Beyond the outcrop of the lower beds of the Cretaceous series in Cambridgeshire and Norfolk, we find a powerful development of the great Jurassic series, but in the only three recorded deep borings in Essex and Suffolk that have pierced through the Cretaceous base, viz., at Harwich, Culford, and Stutton, not a trace of anything Jurassic has been met with, the borings pass suddenly from Cretaceous into far older rocks [Whitaker, Geol. Mag. 1895, p. 466].

Thickness of Chalk at Norwich.

Messrs. J. & J. Colman's well-boring at Carrow proved the Chalk to be 1152 feet; Greensand 6 feet; Gault 36 feet = 1194 feet.

At Stutton boring, Chalk 874 ft. 6 in.; Gault 49 ft. 6 in. = 924 ft.

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At Culford boring, Chalk 526 ft.; Gault 73 ft.; Lower Greensand 32 ft. 6 in. = 631 ft. 6 in.

The Kent Coal Exploration.

At Brabourn, Palæozoic rocks were reached, but no coal.
At Dover, 15 m. to the E. of Brabourn, coal was found!

Beds above the Chalk.

Overlying the Chalk we come to the Tertiary Series.

(1) "Woolwich and Reading Beds" have been observed at Sudbury, and in well-borings at Woodbridge, Saxmundham, and perhaps at Hoxne. Prestwich records them in a well at Yarmouth, 46 feet thick, 310 feet of London Clay, and 170 feet of newer deposits. These Eocene beds are probably present above the Chalk to the east of Surlingham and Wroxham in Norfolk.

(2) "London Clay." This formation was so named by William Smith in 1812, from its development around London. It consists of a stiff brown and bluish Clay, containing layers of septaria or cement-stones which mark the lines of stratification. There is a green and yellow sandy and loamy bed at its base, containing flint-pebbles, sometimes cemented by carbonate of lime into semi-concretionary tabular masses. The top strata are also sandy, passing in places into the lower Bagshot Beds above; much used for *brick-making*, but the bricks are of a bad colour.

The London Clay contains much iron-pyrites and selenite, due to the decomposition of iron-pyrites and the destruction of organic remains; the SO_3 from the pyrites uniting with $CaCO_3$ of the fossils forms selenite. The thickness of the London Clay varies from 50 to 60 feet in Berks, to 500 in S. Essex, often with abundant fossils. The London Clay extends over N. Kent, Surrey, Berks, Middlesex, Herts, and Essex, and the borders of Suffolk to Yarmouth. The fossils of the London Clay, *eroded and often partly coated by* or enclosed in phosphatic nodules, occur at the base of the Suffolk Crag at Felixstowe and elsewhere, and include the teeth of land animals; also crustacea and the teeth of Sharks. Those of *Chelonicæ* are frequently obtained in the Septaria dredged up off the mouth of the Orwell at Harwich.

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These Septaria or Cement-stones were largely used in the manufacture of Roman, Portland, or Parker's cement.*

Passing over the other members of the Eocene series which are wanting in Norfolk, comprising:—

THE LOWER BAGSHOT BEDS, with their sands, loams, pipe-clay and beds of pebbles, 100 to 150 feet in thickness.

THE MIDDLE BAGSHOT BEDS, including the BARTON CLAY and the BRACKLESHAM BEDS.

THE UPPER BAGSHOT BEDS and THE HEADON BEDS, all characteristic of the South and South-east coast.—We next come to THE PLIOCENE SERIES (for the MIOCENE is also *wanting* in England). The English beds classed as *Pliocene* occur chiefly in Norfolk and Suffolk.

The PLIOCENE period embraces:—

The Cromer Forest-bed series.	The Red Crag series.
The Norwich Crag series.	The Coralline Crag series.

1. THE CORALLINE CRAG.

1. The *Coralline* Crag consists of yellow calcareous shelly sands, from 40 to 80 feet in thickness.

The term "*coralline*," refers to the abundant presence of the hard chitinous fronds of Bryozoa (commonly spoken of as "horny Corallines"), which are almost always present in the so-called Coralline Crag. Every one who has walked along the sea-shore will have noticed the delicate fronds of the "Horn-wrack" (*Flustra foliacea*) strewn upon the beach at times. This horny structure is easily seen to be composed of numbers of microscopic cells, and is in fact (like the *Bryozoa* of the "*Coralline Crag*"), the empty composite skeleton (*zoarium*) or *house*, in which hundreds of minute polypes (or *zooids*) once found a home. *The main mass* of the CORALLINE CRAG stretches from Aldborough in the north to Gedgrave in the south, embracing Orford, Sudbourne, &c.

The Coralline Crag is well exposed in the neighbourhood of Alborough and Orford, and at Sutton, Ramsholt, Tattingstone, Iken, Sudbourne, Broom Hill, Gedgrave, Gomer, &c.; the Mollusca of the Coralline Crag have a more southern facies than the Norwich

* PRINCIPAL COMPONENTS: Carb. Lime 64.00, Silica 17.75, Alumina 6.75, Magnesia 0.50, Iron 6.00, Ox. Magnesia 1.00, Water 3.00=100. (Loss 1.00.

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Crag and suggest a milder climate like that of the Mediterranean.

Among its more abundant Mollusca may be mentioned :—

GASTEROPODA.
(Univalves)

Cypræa europea
Voluta Lamberti
Buccinopsis Dalei
Turritella incrassata
Fusus consocialis
Trophon muricatus
Scalaria clathratula
Natica multipunctata
Calyptræa chinensis
Trochus Adansoni
Fissurella græca
Emarginula fissura

BRACHIOPODA.

Terebratula grandis

CIRRIPEDIA.

Balanus crenatus

POLYZOA or BRYOZOA.

Very numerous.

CRUSTACEA.

CORALS.

LAMELLIBRANCHIATA.
(Bivalves)

Anomia ephippium
Ostrea edulis
Pecten opercularis
„ *maximus*
„ *Gerardii*
Pectunculus glycimeris
Nucula nucleus
Lucina borealis
Diplodonta rotundata
Cardita senilis
„ *scalaris*
„ *corbis*
Astarte Omalii
„ *gracilis*
Cyprina islandica
„ *rustica*
Venus casina
Mactra triangula
Panopæa Faujasii

ECHINODERMATA.

Echinus Woodwardii
Temnechinus excavatus

THE *Suffolk* "BONE-BED" OR "COPROLITE-BED."

The occurrence of a pebbly-bed, or a bed of *nodules*, in the Red Crag at Felixstowe, and generally in Suffolk where the base of the Red Crag or the Coralline Crag has been reached, has been described by Professor E. Ray Lankester, D.C.L., F.R.S. (Quart. Journ. Geol. Soc. 1865, vol. xxi. pp. 221—232, Pls. x & xi, and *ibid* 1870, pp. 493—514, Pls. xxxiii & xxxiv.). This bed which is from half a foot to three feet in thickness occurs at the base of the Crag and rests upon the London Clay. It is composed of rounded phosphatic nodules called "coprolites," and water worn teeth and bones of *Mastodon arvernensis*, *Rhinoceros incisivus*, *R. Schleirmachéri*,

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Cervus dicranoceros, *Sus*, *Tapirus*, *Ursus arvernensis*, *Canis vulpes*, *Hyænarctos*, *Felis pardioides*, *Hipparion*, *Hyæna striata*, *Halitherium Canhami*, *Belemnoziphius*, *Choneziphius*, *Trichechus*, *Delphinus*, *Cetotolithes* or ear-bones of Whales (*Balæna*, *&c.*); bones of Bird (*Diomedea*); teeth of Sharks (*Carcharodon megalodon*) *&c.*, *&c.* Professor Lankester considers that the Cetacean remains were derived from the lowest Crag-deposits, known in Belgium as the "*Diestian*" or *Black-crag of Antwerp*. Professor Prestwich believed that the *Mastodon* and *Rhinoceros* of the Crag "Bone-bed" might have lived on land adjacent to the Suffolk area during the period of the formation of the Coralline Crag. The Whales he considered must certainly have existed at that time. Mr. Harmer is, however, strongly of opinion that most of these fossils, found, not in the Crag, but in a *remanié* bed at its base, have been derived from strata older than the East Anglian Crag.

Sir Charles Lyell was struck by the identity in lithological character between the matrix of the round stone bodies containing casts of shells and known as *Suffolk* "*Box-stones*," and certain beds of the Antwerp Crag seen at Berchem; he had no doubt that they had been derived from that deposit. He thought that the area between Belgium and England might have contained a large number of terrestrial beds which eventually left certain of their contents to be mingled together in the lower beds of the later marine deposits of Suffolk.

Ear-bones of Whales, and teeth of *Carcharodon* attached to nodules of glauconite and manganese closely resembling those of the Suffolk Crag, were dredged up by the "*Challenger*" in deep water in the Atlantic and elsewhere.

Sir John Murray believes that all these phosphatic nodules have been similarly formed in deep water deposits by *chemical action* upon the organic matter on the sea-floor and in the sea-water. The teeth of the Sharks are being dissolved away by this action, leaving often only a shell of enamel behind.

Similar vast accumulations of marine and land animals with phosphatic matter have been met with in Tertiary deposits at Charleston, Carolina, and of mammalian remains in France at *Caylux*.

The Cambridge Greensand and the Potton Beds are also examples of phosphatic deposits of a similar nature to the Crag, but older than Tertiary.

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The Red Crag.

This deposit consists generally of dark red shelly sand, exhibiting false-bedding, and having a thickness rarely exceeding twenty-five feet. Sometimes the colour is yellow, brown, or grey. Seams of laminated clay are occasionally met with in it. The Red Crag is well shown at Walton-on-the-Naze, Felixstowe, Waldringfield, Sutton, Ramsholt, Butley, and other places. At Tattingstone, near Ipswich, at Sutton, and at Sudbourne, the Red Crag is seen in section *superimposed upon the Coralline Crag*, but the beds are more or less unconformable. Over the greater part of the area the Red Crag rests on the London Clay.

Like the Coralline Crag, the Red Crag contains at its base a bed of derivative fossils which have been washed out of the London Clay, such as the teeth of sharks, *Lamna elegans*, Crabs, and some London Clay *Mammalia*, vertebræ of fishes, &c. *Many of these are phosphatised.*

Among the more common Mollusca of the Red Crag may be mentioned:—

Gasteropoda.

Trophon (Fusus) antiquus
" " *contrarius*
Purpura tetragona
" *lapillus*
Nassa granulata
" *reticosa*
Buccinum undatum
Natica catena
" *multipunctata*
Littorina littorea
Turritella incrassata

Lamellibranchiata.

Mactra arcuata
" *ovalis (solida)*
Tellina obliqua
" *crassa*
" *prætenuis*
Lucina borealis
Cardium edule
" *angustatum*
Mytilus edulis
Pecten opercularis
Pectunculus glycimeris

Echinodermata.

Echinocyamus suffolciensis

Crustacea.

Balanus crenatus, &c.

The Red Crag is generally *more ferruginous* than the shelly sands of the Coralline Crag, hence its name. The Coralline was originally

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called the "White Crag" formation, but the upper part of the latter is also highly ferruginous.

Norwich Crag.

The Norwich Crag, so called by Lyell in 1839, is composed of a variable group of sands, pebbly-gravels, and laminated clays, with seams and patches of shells. These beds (in Norfolk) rest on the Chalk; sometimes as at Thorpe pit near the Asylum, the *Annelides* of the Crag sea have bored into the eroded Chalk floor for several inches.

4. Buff and red false-bedded sand and gravel, flint, pebbles, (iron-pan) seams of laminated clay sometimes cemented by iron.

3. Laminated clay with seams of sand and gravel, "Chillesford Clay."

2. White and brown sand with pebbly gravel and iron-stone nodules, sometimes called "Fluvio-Marine-Crag."

1. Unworn and rolled flints called the "*Mammaliferous stone-bed.*" Shells are often absent. They are most frequent in beds one and two, to which the term "Norwich Crag" has usually been restricted.

Mammalian remains, no doubt derivative, occur in No 1 bed, as *Elephas*, *Mastodon*, *Hippopotamus*, *Cervus*, *&c.*; among the more characteristic Mollusca may be mentioned :—

Gasteropoda.	Lamellibranchiata.
Natica catena	*Tellina obliqua*
„ *clausa*	„ *lata*
Littorina littorea	„ *prætenuis*
Conovulus pyramidalis	*Cardium edule*
Paludina media	*Astarte borealis*
Purpura lapillus	„ *compressa*
Trophon antiquus	*Mytilus edulis*
Turritella terebra	*Mya arenaria*
Cerithium tricinctum	*Mactra ovalis*
Scalaria groenlandica	„ *subtruncata*
	Brachiopoda.
	Rhynchonella psittacea
	Cirripedia.
	Balanus crenatus
	„ *porcatus*

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The NORWICH CRAG also covers a large area in Suffolk, as at Hoxne, Halesworth, Easton-Bavent, Dunwich, Saxmundham, Leiston, and Thorpe by Alboro'.

THICKNESS OF THE CRAG.

Recent information, derived from borings in search of water, show that the Norwich Crag is a more important deposit in *thickness* than was formerly supposed.

A boring at Messrs. Youngman and Preston's Brewery at Lowestoft has been carried about 180 feet below sea-level without piercing the Crag; the lowest bed reached being *apparently* NORWICH CRAG.*

At *Beccles*, the NORWICH CRAG series (if we include thirty-three feet of Pebbly gravel) was proved to be 129 feet in thickness; and at *Southwold* 147 feet of Shelly Crag—all of Norwich Crag age—was proved in a boring for water-works, 1886—87.†

At *Saxmundham* Brewery, 105 feet of CRAG, probably of Norwich Crag age, was proved in the well-boring.

CLIMATE OF THE SUFFOLK CRAG PERIOD.

Mr. F. W. Harmer observes:—"A considerable percentage of the species of mollusca found in the oldest Crag beds (Coralline and Walton Crags) some of them survivors from Miocene times, are not known living; as to the rest, the general character of the fauna is more or less similar to that of the Mediterranean at the present day, the presumption being that the climate of the Eastern counties of England was somewhat warmer at that period than it now is. The upper zones of the Crag, however, those represented by the Butley, Norwich, and Weybourn deposits give evidence of more boreal, and even of arctic conditions.

THE FOREST-BED SERIES OF THE NORFOLK COAST.

A portion at least of the Norwich Crag Beds (known as the "Chillesford series") underlies the "Forest-Bed" at Kessingland and Corton.

4. The Cromer or *Forest-Bed series* extends for a considerable distance around the Norfolk coast, and, although not always to be

* Geol. Survey, Summary of Progress, 1898, p. 146.

† Reid, Pliocene Deposits of Britain, p. 104.

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seen, is often exposed in places on the beach after storms which have scoured the beach and laid this bed bare.*

It is of Preglacial age, although it has sometimes been grouped as *Pleistocene*, and contains the fossil remains of *Machærodus*, *Trogontherium Cuvieri*, *Elephas meridionalis*, *E. antiquus*, *Cervus dicranoceros*, *Rhinoceros etruscus*, *Equus fossilis*, *Cervus bovoides*, *C. Sedgwickii*, *C. verticornis*, *Hyæna crocuta*, *H. spelæa*, *Hippopotamus amphibius*, *Ursus ferox*, *Gulo luscus*, and others.

It occurs below *the Glacial Drift* and above the Weybourn Crag, with a total thickness of twenty to thirty feet. It has been divided by Mr. C. Reid into an Upper Freshwater Bed, Forest Bed so called (Estuarine), and a lower Freshwater Bed.

Among those who have collected from the Forest-bed may be mentioned the Rev. John Gunn, Rev. Jas. Layton, Mr. S. Woodward, Rev. S. W. King, Mr. Randall Johnson, and Mr. Savin of Cromer. Its mammalian fauna has been described by Mr. E. T. Newton F.R.S., Mus. Pract. Geol., Jermyn St. For collections of fossils, see British Museum of Natural History, Cromwell Road; Jermyn St. Museum, and the Castle Museum at Norwich.

Glacial Period, Boulder Clay, &c.

The Chalky Boulder Clay occupies a large area of Central Suffolk, *west of Ipswich*, *Woodbridge*, *Saxmundham*, *and Halesworth*. The Rev. E. Hill of Cockfield observes: "It rises up to a height of 340 feet; but none of the neighbouring outcrops of Chalk reach 300 feet, so that the denudation of the Chalk must have been very considerable."

"The Boulder-clay" is connected by geologists with a period of extreme cold which spread over the northern parts of Europe in Pleistocene times, when the higher lands were covered with snow and ice, and when icebergs and floe-ice brought and deposited erratic blocks from distant parts of the North of England, and from Scandinavia.

But even this geological cataclysm was not devoid of benefit to mankind, for it left behind it soil which forms some of the best corn-lands in England.

The late Dean Buckland remarked, 80 years ago, that he always knew when he was travelling over the Boulder Clay, by the happy and contented faces of the agricultural population whom he met.

* It extends from Weybourn in Norfolk to Kessingland in Suffolk.

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I hope it is the case in the Boulder Clay districts of Norfolk and central Suffolk to-day.

Submarine Deposits off the Coast.

All along the East Anglian Coast (from *Essex, Suffolk, Norfolk, and Lincolnshire to Yorkshire*) deposits have long been known to exist on the floor of the North Sea (which is here comparatively shallow) which at times form banks, as the "*Dogger-bank*," of very large extent, the "*Knole-sand*," the "*Scroby-sand*," and many others. These banks have been the favourite resort of our fishermen from very early times for trawling and line-fishing. We have records extending over more than a hundred years, showing that the fishermen were in the habit of hauling up in their trawl-nets vast numbers of bones of extinct animals, grinders and tusks of Elephants, antlers of Deer, and horn-cores of Musk-ox and Bison. These were at first destroyed (with many imprecations) on account of the damage to their nets; but at last there grew up a considerable number of curious and observant Naturalists and Geologists, who encouraged the fishermen to preserve these remains. Hence the collections of the Rev. J. Layton, Mr. Taylor, Mr. J. J. Owles of Yarmouth, Samuel Woodward, Rev. John Gunn, Mr. Backhouse, Mr. J. J. Colman, M.P., Mr. Savin, and many others. Thus a large number of interesting records have been preserved of this old submarine land. One very striking feature of the remains is that *they have not been rolled* like those found in the nodule beds at the base of the Coralline and Red Crags, but retain their original sharpness as if they had been quietly left on the old land-surface where the animals had died. But for the fact that they represent a younger fauna than the Norfolk Forest-bed one would have wished to correlate them with that deposit so near at hand. But a long period of time must have intervened between the two, and it serves to show how many periods of past geological time are represented by these fragmentary deposits left to us in East Anglia and upon its coasts.

Quarternary Deposits and Prehistoric Man.

The latest changes brought about were due to *local causes*, floods, and river-action, leaving behind, in the present or former valleys, deposits of brick-earth and gravel. One such deposit was noticed

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by Mr. Frere at Hoxne on the Waveney (in 1800), where Palæolithic flint implements lay in great numbers at a depth of twelve feet in stratified soil which was dug into for making bricks. These implements were associated with Rhinoceros, Deer, Horse and Elephant, and with shells of *Cyclas*, *Pisidium*, *Unio*, *Bithynia*, *Helix*, *Limnæa*, *Planorbis*, *Succinea*, *and Valvata*.

Since then numerous other discoveries have been made, more especially in the last forty years, in different parts of England, revealing similar types of Prehistoric remains. At Mildenhall, at Thetford, Livermere, in the valley of the Little Ouse, &c., &c., such evidence has been obtained, whilst attempts have been made by Mr. S. B. J. Skertchley and the late Dr. J. E. Taylor to prove the existence of Man even in the Crag Period!

In conclusion, I have only to add that those of my hearers who have been sufficiently interested by this brief sketch of East Anglian Geology to desire to read a fuller account of the physical conditions existing in this area in later Tertiary times may consult with advantage the admirable series of papers published by the late Mr. Searles V. Wood, Jun., and Mr. F. W Harmer, and subsequently by Mr. Harmer alone, on the Geology and Climate of Eastern England and its later Tertiary History.*

My thanks are also due to Mr. Harmer, who, in my unavoidable absence, kindly undertook the reading of this paper for me, and superintended the exhibition of the series of lantern slides with which it was illustrated.

* S. V. Wood. Jun., and F. W. Harmer:—
"An Outline of the Geology of the Upper Tertiaries of East Anglia," with Map and Sections. Pal. Soc., Supp. Crag Mollusca, pp. 2-31, 1872.
"Later Tertiary Geology of East Anglia." Quart. Journ. Geol. Soc., vol. xxxiii. pp. 74–119, 1877.

F. W. Harmer:—
"A third Boulder Clay in Norfolk." Quart. Journ. Geol. Soc., vol. xxiii. pp. 87–90, 1866.
"The Kessingland Cliff Section." Quart. Journ. Geol. Soc., vol. xxxiii. pp. 134–140, 1877.
"The Pliocene Deposits of Holland, and their Relation to the English and Belgian Crags." Quart. Journ. Geol. Soc., vol. lii. pp. 748–781, 1896.
"The Lenham Beds and the Coralline Crag." Quart. Journ. Geol. Soc., vol. liv. pp. 308–354, 1898.
"The Crag of Essex, Waltonian." Quart. Journ. Geol. Soc., vol. lvi. pp. 705–743, 1900.
"The Influence of the Winds upon Climate during the Pleistocene Epoch." Quart. Journ. Geol. Soc. vol. lvii. p. 405–476, 1901.
"A Sketch of the Later Tertiary History of East Anglia." Proc. Geol. Assoc., vol. xvii. pp. 416–479, 1902.

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V.

THE MERES OF WRETHAM HEATH.

By W. G. Clarke.

Read 27th January, 1908.

The remarkable pools of water called Meres, or locally "Pits," situated on the extensive heathland north of Thetford and close by the boundary between the parishes of Wretham and Croxton have hardly received the attention they deserve. Various writers have made bare mention of them; some because of their strange formation or picturesqueness; others, within the past twenty years, because of the almost unique character of their bird-life, Mallard, Gadwall, Shovelers, Teal, Garganey, Pochard and Tufted Duck, having been known to nest in the vicinity of one or the other of these meres. This aspect of the subject need not now be dwelt upon, although the question will naturally occur in connection with the strange fluctuations in the area of the meres, the subject with which I propose to deal, the facts solely relating to Ringmere, Langmere, Fowlmere, and the Devil's Punch Bowl.

The meres have neither visible inlet nor outlet and are only found in that portion of the district where the chalk comes to the surface or is only thinly covered by sandy drift. As to the origin of these sheets of water we must accept the opinions of expert geologists. Mr. F. J. Bennett, F.G.S., thinks that many small meres have become dry through the lowering of the water-level in the chalk, consequent upon increased cultivation and drainage. "Pipes" in the chalk were filled with drift-sand. These, after a heavy rainfall, would be filled with water, so far as they were affected by the

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water-level of the chalk. As this level rose, so would the water ascend and thus enlarge the areas until the basins were formed. Sir John Evans has noted that in Hertfordshire the chalk level of saturation has varied as much as seventy feet in the course of a single year. A process similar to that by which these meres were formed is even now going on in the neighbourhood of Thetford, and extensive subsidences have taken place. Mr. Bennett thought that the meres were fed by springs from the chalk at the same level, as they were all nearly the same height above the sea. Dr. J. E. Taylor said in 1871 that the meres dried up during drought, their water supply being simply the storage of the wet seasons. Dealing with the meres of Norfolk generally, he did not think many were fed by springs, because they were frequently active during seasons of drought. Mr. Robert Stevenson, the tenant of Fowlmere Farm, says he is certain that Fowlmere is fed by surface water and not by any spring. Later, we shall see in which direction the evidence tends. The fact that three of the more northerly meres contained, when drained, traces of the pile-dwellings of prehistoric man, proves that these pools have not been formed during the historic period.

Ringmere.

In the collection of Norse sagas known as the "Heimskringla" mention is made of a battle fought on "Hringmar Heath," probably in the year 1010 A.D. There appears to be no further mention of the spot until, in 1724, or the following year, Salmon, the author of "Roman Stations" saw a "remarkable cavity called Ringmere Pit." He said:—"It is in the form of an amphitheatre to the bigness of six or seven acres with an uniform descent on every side to the arena. There was not in the latter end of October a drop of water in it, which the wet summer must have filled if it had been a pond." Writing in 1739, the Rev. Francis Blomefield said that there was in this nothing uncommon to those acquainted with it. It was generally full of water, he said, and the ground being a sand the water occasioned the uniform descent. He continued thus:—"It is supplied with landsprings from the adjacent hills (*sic*) which in the extreme dry year ceased running and so the water shrank into

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the sand." When a schoolboy at Thetford he had angled fine perch out of it, and thought it was artificially stored with fish after being dry. For over a hundred years there seem to have been no references to the meres, until Mr. Henry Stevenson wrote an excellent account of his visit on August 8th, 1869. Ten years previously Ringmere was quite dry. A hole about four feet deep was then dug in the middle of the mere, but supplied no water. There are traces of some such excavation now. An old shepherd once told me that nettles of gigantic size grew in the bed of the mere at this time. In the hot summer of 1868 the water was very low in all the meres but they were never quite dry. It was recorded then, and a similar state of affairs has occurred several times since, that in very wet seasons the waters of Ringmere have flowed over the highway on its eastern side till the horses were knee-deep in passing through, and covered the low-lying part of the heathland for a mile or so. The members of the Ordnance Survey visited this district in 1882 when all the meres were very full of water. Ringmere was then about 250 yards long and 150 wide at its widest part. Mr. T. Southwell, who has kindly allowed me to see his notes, records that on June 5th, 1882, all the meres were very full of water. On Ringmere there were two old Shovelers with broods of young—one had eight—some Coots, and several Little Grebe, and a similar record was made on May 29th, 1884, when, despite the drought, the waters were higher than in the previous year. At Ringmere, on May 19th, 1887, Mr. Southwell saw the following birds, viz., Pochard, Tufted Duck, Mallard, Shoveler, Green Sandpiper, Cuckoo, and Stone Curlew, and a Gadwall on the wash-pit close by.

My personal acquaintance with the meres dates from 1889. At four visits between April and September of that year the water in Ringmere was at a medium height, namely about twenty feet from the crown of the road to the verge of the pool. The levels changed but little during 1890. After a heavy shower of rain on September 7th a large number of Stone Curlews flew down to the mere from the surrounding heathland, all whistling during flight, and apparently finding food among the scrubby grass and rushes that surround the pool. On April 2nd, 1892, the meres were extremely high. Thousands of empty shells of *Limnæa stagnalis* floated about close to the edge of the water. Twenty-seven Coot

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and a pair of Mallard, were swimming on Ringmere on March 25th, 1893, the water then being at a medium height. On the 15th of the following April, the only birds on the mere were a pair of Little Grebe. The water was rather low on May 26th, 1894, but Coots were present in abundance. The autumn was a very wet one, yet on November 25th, Ringmere was lower than I had previously seen it. There was no sign of life on or around it. Where the waters had receded, thousands of empty shells of the freshwater whelk had been left on the mud. There were four distinct zones, each several inches in width quite round the mere. The water was still very low on Christmas Day and a Hooded Crow was the only sign of bird-life. Early in September, 1895, the level was approximately the same, with about twenty Coots on its surface. It had changed from its usual circular form to a more oval shape. It was much higher on November 6th of the following year. There was scarcely any water in Ringmere, as Mr. Southwell records, on March 18th, 1899. In the September 1901 all the meres became quite dry. Ringmere was so dry May 17th, 1902, that I walked all over its bed. The mud had become grass-grown and was fissured as one might suppose it would be from a miniature local earthquake. Shells of *Limnæa peregra* were almost as common as those of *L. stagnalis*. A few birch posts projected from the mud on the northern bank of the mere; but there is said to have been at one time a boathouse on the spot. The bed of the mere was fairly level, save for one place about six feet across and six inches lower than the remainder. This is almost in the centre, but slightly nearer the southern shore, and may possibly be the result of excavation when the pit was last dry. When Hill Mere was drained, a circular hole about 4½ feet in diameter, and some six feet deeper than the bottom of the mere was found, and seemed to have been the site of a pile-dwelling. There were no traces of moles in the bed of Ringmere, but numerous well-defined hare and rabbit runs were beaten down smooth in striking contrast to the remainder of the surface. On September 4th, 1902, the bed of Ringmere was filled with a closely-matted growth from a foot to eighteen inches in height of spotted persicaria and curled dock, while on the old shores were scorpion grass and golden water-dock in abundance, but no trace of water.

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Langmere.

It may be well to define the positions of the meres. Ringmere is on the western side of the road leading from the Thetford-Norwich highway to East Wretham. To the east is the highway, to the north and west the heathland, while on the south is the base of a triangular plantation of firs, beech, larch, and silver birch. Croxton and Kilverstone parishes both reach Ringmere—seven parishes have the right of there watering sheep—and the boundary between them is that of the Shropham and Grimshoe hundreds. The Croxton boundary touches Ringmere, then goes to Langmere, continuing along the northern bank of the "Drove," a well-defined green trackway which runs from the fenland at Hockwold to Roudham heath and seems to the writer to be undoubtedly pre-Roman. It follows the high chalky ridge and divides Ringmere and Langmere, and Fowlmere and the Punch Bowl.

Blomefield, in 1739, said that other large pits on the heaths were mostly dried up in the summer-time and had water in them in winter. When Ringmere was dry in 1859 water was found in a pond between that mere and Langmere and also near the highway towards Wretham. Both these ponds still exist. About sixty Blackheaded Gulls flew from the former in June, 1898, and there was ample proof that they had nested there in greater numbers than they had previously done since 1883, which in its turn had eclipsed previous years. On May 17th, 1902, when Ringmere and Langmere were quite dry, this pool was half full of water and a pair of Mallard rose from it, and flew round overhead. It is on a decidedly higher level than either of the adjacent meres, and is probably supplied by surface water and not from the chalk. There was still a good depth of water on September 4th, 1902, but no sign of wild fowl.

Langmere is of long oval form and when full is a quarter of a mile from end to end, with an island on which are Scotch firs and gorse in the centre. It was quite dry in 1859 and ten years later only reached one third of its proper extent. Mr. H. Stevenson then saw on its surface ten or twenty couple of Duck and Mallard, a female Shoveler, and two or three couple of Grebe. Not long previously the grassy knoll had been almost an island, the waters

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surrounding it in all but one spot. At night, stock were driven across the isthmus and securely folded within a natural inclosure. On June 5th, 1882, as Mr. Southwell records, the tumulus-like knoll was surrounded by a broad sheet of water. There were great quantities of Coot, Grebes, Gulls, Tufted Duck, Pochard, Shovelers, and Common Duck, many with broods. It was at that time about 440 yards long and 275 wide. On June 27th, 1882, there were Gadwall and Great Crested Grebes on Langmere, and Mr. J. H. Gurney caught a young Teal on the shore. There was a large number of ducks' nests and eggs on the shores of the mere on May 29th, 1884. Tufted Ducks and Common Ducks were more common than previously, Pochards less so, Teal about as usual. Young Gadwalls were seen, and Coots were very common. Mr. C. J. Staniland, R.I., visited the mere in July, 1887, and describing his visit in the 'Graphic' of October 15th, he said of Langmere :— "It is the most impressive of the meres that we saw, lying in the midst of a wild scrubby heath, not a sound but the melancho' wailing of the Peewit or the scream of a Gull to break the silenc· the dozen or so of fir trees on the peninsula standing up solitary grandeur against the sky. The immediate surroundings of the mere a dried-up, starved, stalky growth of thistles and what-not." In 1889 Langmere was well filled with water, and the level changed little during 1890. Hundreds of wild fowl, a goodly proportion of which were Coots, disported themselves on the mere on March 25th, 1893. The water was then extremely high. The mere was divided into two large ponds, one round, the other oval, on May 26th, 1894, and there were several Coots' nests near the shore. By September 27th of the same year the waters had quite disappeared. In 1895 it was partly refilled, and on November 6th 1896, the volume of water had still further increased. There was a flock of about 200 Coots on the mere, and I successfully watched their movements by creeping on the knoll and sheltering behind the gaunt firs. Langmere was very low in June, 1898, but a dozen brace of Wild Duck flew from it ere I could distinguish the species. On March 18th, 1899, Langmere was, as Mr. T. Southwell notes, only a long splash, and with the other meres was quite dry by September, 1901. A visit on May 17th, 1902, proved that in spite of various opinions to the contrary, Langmere when full of

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water must be the deepest of the meres. The long pool on the northern side had apparently been dry for some considerable time, for the bed was covered with grass and seemed to be the playground for hundreds of rabbits, which scampered off at our approach. The water had obviously remained longest in a circular hollow eastward of the knoll, for this still retained an element of moisture. It was everywhere undermined with mole runs, and one could nowhere find a clear space of a foot square which had not thus been tunnelled. Among the tufts of grass were thousands of shells of *Limnæa stagnalis*. A further visit on September 4th showed little change, save that the grass had grown somewhat higher.

Fowlmere.

This, the largest of the heathland meres, lies about a mile west of Langmere on the northern side of the "Drove." It is nearly three times as big as Ringmere and was also dry in 1724—5. It lies partly in Croxton and partly in Wretham, and when Blomefield wrote in 1739 the Croxton part of the fishery pertained to the estate of the Thetford School and Hospital Foundation. For a century there appears to be no further mention of it, but on June 16th, 1842, as recorded on a tombstone in the churchyard of St. Mary's, Thetford, John Goodbody and Edmund Craske of that town, were accidentally drowned in Fowlmere, which must at that time have been fairly high. When Langmere and Ringmere were dry in 1859, Fowlmere consisted of a small pond at the northern end of the basin. All the other portion, as Mr. Henry Stevenson records, was a flourishing crop of wheat, oats and vetches. The last did not do well, and were therefore mown, cabbages being substituted. There was a tradition that Fowlmere had previously been dry and that a crop of oats grown upon it was entirely lost by the sudden influx of the waters. Mr. Robert Stevenson of Fowlmere Farm, says that the mere was quite dry in the summer of 1862, and was then planted with cabbages. This is possibly a confusion of date, or the mere may have remained practically dry for several years. When the mere only occupied a circumscribed area, before becoming quite dry, a Croxton man, named Taylor, secured twelve stone of fish at this spot. Mr. Henry Stevenson

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wrote in 1869: "Charming as is the aspect of this wide expanse of water with its green islets and thick belt of rushes at the further end, there is an absence of that utter wildness of character which marks the other two." The mere showed evidence of having extended far beyond its area in 1869, and a crop of grain was fenced in and grown on the reclaimed soil. The water was extremely deep in places, and contained good Perch. Mr. Robert Stevenson says that Fowlmere gradually increased in size from November 1862, until March 1883, when it was eighteen feet deep in parts and covered thirty acres. According to the Ordnance Survey map, in 1882, the mere was 528 yards long and 330 wide; a fine sheet of water for that part of the county. On June 5th of that year, Mr. Southwell saw a large number of Ducks on this mere, five, with their broods, being under the field of his glasses at one time. In January, 1884, the mere covered a considerable area and there were two smaller meres on the eastern side. Later in the year several fields were flooded in spite of the drought, and a noteworthy item in nidification was that a number of waterhens' nests appeared to be built in old blackbirds' nests in the hedges. The following year the mere was reduced to half its extent in 1884. Mr. C. J. Staniland visited Fowlmere in July 1887, and in the 'Graphic' of October 15th, had a sketch of the mere, reproduced in the 'Daily Graphic' of August 30th, 1890, and the following brief description:—"Fowlmere repaid us for all our exertions. Imagine a solitary pool surrounded by firs at one end and open country at the other, swarming with Peewit, Teal, Duck and Seagulls, set in the midst of a lonely heath." In 1889 and the following year this mere was well filled with water. It was higher than usual on May 26th, 1894, and the wind raised moderate-sized wavelets that beat on the marge. The mere had overflowed part of the western shore and the green tops of the bushes just peeped above the surface for some yards from the edge of the water. Fowlmere was still as high as it had been in the previous May on January 12th, 1895, when every part was frozen over and provided a splendid area for skating. The difference in the rhythm sufficiently attested the difference in depth in the various parts of the mere. The northern end was much the deeper, further proved by the fact that this remained open much longer than other

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portions. In 1896 the dog of the shepherd who then lived close by the Punch Bowl, would go into Fowlmere and catch the sluggish Tench which there abounded—often bringing out large-sized specimens. This mere was fairly high in June, 1898, but by March 18th, 1899, it was almost dry. In September of that year the waters covered half their full area, and on the 26th, over 150 dead Tench lay upon the southern shore. Before the heavy rains of the previous week or so the waters had been lower and as many more Tench, ranging from one to three pounds in weight, had been exposed. Mr. R. Stevenson of Fowlmere Farm says in a letter to the writer that Fowlmere gradually decreased from 1883 to September, 1901, when it became quite dry. He had it harrowed and ploughed without any difficulty. The horses could walk as well as though on an ordinary field, with the exception of two low places, where the animals were not allowed to go. As the mere lies half in Croxton and half in Wretham the occupier of each farm planted about four acres of beet, swedes, and cabbages. When I visited the mere on May 17th, 1902, it was absolutely dry and apparently about two-thirds of the bed of the large pool was ploughed up and partly protected by wire netting. The soil seemed a stiff loam, rather chalky, and contained numbers of large flints. The bed of the mere slopes downwards from east to west, the lowest part being at the north-west, but there was nowhere any indication of moisture. The extremely stony beach on the eastern shore had not been ploughed up. On the high land close by I found a number of Neolithic flint implements, also a Wood Wren's nest with six eggs, neatly built beneath the sere and overhanging bracken fronds of the previous year. The aspect of the southern end of the mere has been greatly changed of late years by the planting of trees. On September 4th there was promise of a splendid root crop in Fowlmere. A belt of ground across the middle of the mere, dividing the parochial areas, was covered with weeds, chiefly spotted persicaria, while thistles and nettles flourished exceedingly around the borders. The promise of a good crop was fulfilled. From the Croxton portion of the mere a swede weighing twenty-three pounds, and a cabbage weighing fifteen pounds, were taken, and exhibited in Thetford market on November 8th. On the Wretham portion there were about 2½ acres of beet from

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which 126 big cart loads were taken, or about forty tons per acre. The roots were large, many of them twenty-eight inches in circumference, sound and of good quality, the best crop Mr. Robert Stevenson had ever seen. From half an acre of drumhead garden cabbage between fifty and sixty loads were taken. These were of excellent weight and quality but would have been larger had cattle cabbage been planted. Carting was quite easy; in the middle of November the bed of Fowlmere was as dry as any upland field. Rabbits had burrowed deeply into some parts and the soil brought up from the greatest depth was quite dry. During agricultural operations part of an old harrow was found in the soil. The woodwork had decayed, several iron teeth alone indicating the nature of the implement. This might have been a relic of the 1859—62 dry period or even of some earlier occasion.

The Devil's Punch Bowl.

This, the smallest of the four heathland meres, lies to the sou . . west of Fowlmere on the further side of the "Drove." Althou its basin is the most typical in formation of any of these meres . have fewer observations concerning it. A sketch of it by Mr. C. J. Staniland appeared in the 'Graphic' of October 15th, 1887, and the 'Daily Graphic' for August 30th, 1890. Both in 1889 and 1890 there was a good depth of water in the mere. On July 26th, 1894, there was on the contrary very little and that of inky blackness. A similar state of things existed in June, 1898, when two Moorhens flew from the water and sheltered among the bracken half-way up the slope. On March 18th, 1899, there was only a wet spot at the bottom of the basin, and in the summer of 1901 it became quite dry, as it still was when I visited the spot on May 17th, 1902. Towards the southern edge of the mere was a small hollow several feet below the general level of the bed. One can never get a better idea of the remarkable character of this mere than by standing in the middle of the pit when it is dry. On the table-land above, a line of gaunt firs cuts off the outside world. Towards the mere there is next the level turf, and then a sharp descent of between twenty and twenty-five feet, forming the huge circular basin which popular fancy pictured as the

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"Devil's Punch Bowl." The patch of mist that sometimes hangs over the mere at night time is also called the "Devil's Nightcap." Two-thirds of the sloping sides of the mere are covered with bracken, and from that there is close slippery turf to the gravelly beach which edges the black mud in the bed of the mere. In 1882 the water had a length and breadth of 110 yards. In May last the basin contained discoloured skulls of Sheep, Lambs, Dogs, and Cats, and the mud was covered with decaying water-weeds. The mud in drying had fissured in every direction. In the bed of the pool I found a Neolithic flake and a scraper. I was informed that the water in the well belonging to the cottage on the southern side of the mere had been low, owing to the small rainfall, but never so low as to cause any serious difficulty. On September 4th there was little difference in the aspect of the mere, save that the grass and vegetation had increased somewhat in height.

Conclusions.

In addition to the various opinions recorded in the introduction, Mr. Henry Stevenson said in 1869, that it had been asserted that the meres never covered so large an area after Wretham West Mere was drained in 1851, and Great Mere in 1856. In 1884, on the contrary, Mr. F. J. Bennett wrote:—"Since Mickle Mere was pumped dry and deepened in 1856 the water has stood higher in them all and none have since been dry." Many Thetford people assert that the meres have been gradually getting dry since the well was made at Thetford Waterworks in 1876. It has also been stated that there is most water in the meres in the driest summers, and similarly that in the winter-time the waters of the Punch Bowl receded, rising as the heat of summer increased. Facts prove that there is as little reason in these contentions as in the tradition which said that the price of corn rose with the waters of Ringmere. In 1859 the mere was dry and wheat was £11 per ton; in 1884 it was full to overflowing and wheat was £8 19s. per ton. It can, I think, be shown that the rainfall is solely responsible for the fluctuations of the water in the meres, not as surface water —or why should ponds and wells on higher levels contain water when the meres are dry?—but so far as the rainfall affects the

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level of saturation in the Chalk. The height above sea-level of the beds of these meres is apparently about the same. To the east of Ringmere the road is 106 feet above sea-level; the "Drove" immediately south of Langmere is 110 feet above sea-level, the track rising to 137½ feet at the plantation about mid-way between Langmere and Fowlmere. Nearer the latter mere a height of 140 feet is attained, dropping at the southern end of the mere to 120·8 feet. Taking the years 1859 and 1862, one or both of which were dry years so far as the meres are concerned, 1882 which was a full year, and 1902, which was a dry year, and comparing the Norfolk rainfall for periods of five and ten years preceding, we get the following data: In the ten years from 1872 to 1881, inclusive, the rainfall was 277·62 inches; from 1849 to 1858, 224·33 inches; and from 1852 to 1861, 226·04 inches; while from 1892 to 1901, inclusive, the rainfall was 243·61 inches. Between the ten-year dry periods and the ten-year wet periods there is thus a maximum difference of fifty-three inches or 5·3 per year, and a minimum difference of thirty-four inches or 3·4 per year. In the five years preceding the full meres of 1882 and the dry meres of 1862 and 1902 the figures show a far greater divergence. The rainfall from 1854 to 1859, inclusive, was 102·31 inches; and from 1857 to 1861, inclusive, 112·18 inches; from 1897 to 1901, inclusive, 117·39 inches; while in the wet period of 1877 to 1881, inclusive, the rainfall was 149·69 inches. This shows a maximum difference in the quinquennial periods of forty-seven inches or 9·4 per year and a minimum of thirty inches or six per year. This seems quite sufficient to account for the remarkable fluctuations of the water in these meres, while the fact that in the intervening periods one mere is sometimes high while at the same time another close by is low, may perhaps be due to the slight differences in level. For instance, if the saturation level were eighteen feet beneath the ordinary surface, a mere whose bed was nineteen feet from the surface would contain a foot of water when one whose bed was seventeen feet from the surface would be quite dry. It may also be noted that in 1882 when the meres were at their highest level for many years, the rainfall was 33·34 inches, the highest yearly register for many decades.

Reasoning from previous experience it may therefore be

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anticipated that with an increased rainfall the chalk level of saturation will rise, and the beds of these meres once more become filled with water and serve as the nesting-places of some of the rarer wild-fowl.

FLUCTUATIONS IN THE MERES OF WRETHAM HEATH.

Date.	Ringmere.	Langmere.	Fowlmere.	Punch Bowl
1712—20	Full	—	Full	—
Oct. 1724—25	Dry	—	Dry	—
June 16th, 1842	—	—	Fairly high	—
1859	Dry	Dry	Nearly dry	—
1862	Dry	Dry	Dry	Dry
1868	Low	Low	Low	Low
Aug. 8th, 1869	Fairly high	Low	Low	—
June 5th, 1882	Full	Full	Full	Full
1883	Full	Full	Full	Full
May 29th, 1884	Full	Full	Full	Full
May 19th, 1887	Fairly high	Fairly high	Fairly high	Fairly high
July 1887	—	Fairly high	Fairly high	Fairly high
1889	Medium	Fairly high	Fairly high	Fairly high
Sept. 7th, 1890	Medium	Fairly high	Fairly high	Fairly high
April 2nd, 1892	Full	Full	Full	Full
Mar. 25th, 1893	Medium	Full	—	—
May 26th, 1894	Low	Low	Full	Low
Sept. 27th, 1894	—	Dry	—	—
Nov. 25th, 1894	Very low	—	—	—
Dec. 25th, 1894	Very low	—	—	—
Jan. 12th, 1895	—	—	Full	—
September, 1895	Low	Low	—	—
Nov. 6th, 1896	High	High	—	—
June 1898	Low	Low	Fairly high	Very low
Mar. 18th, 1899	Nearly dry	Nearly dry	Low	Nearly dry
September, 1899	—	—	Nearly dry	—
September, 1901	Dry	Dry	Dry	Dry
May 17th, 1902	Dry	Dry	Dry	Dry
Sept. 4th, 1902	Dry	Dry	Dry	Dry

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VI.

PYROLA ROTUNDIFOLIA, L., IN EAST ANGLIA.

By Arthur Bennett, F.L.S.

Read 27th January, 1903.

If you look at a map of England and mark the Counties in Mid. and E. England in which this species occurs, you will see how curious its distribution is. It occurs in E. and W. Kent! E. Suffolk! (extinct?). Norfolk E! and W., and then not till Worcester, Stafford! and Salop, in all of which it is very rare; then to Flint! Yorkshire and Lancashire! In no southern county is it recorded except Sussex, where there is an old unconfirmed record for it. But in last August (1902) it was found in E. Sussex and sent to the Rev. E. N. Bloomfield. It is given in the 'Flora of Herts,' p. 269, 1887 (by A. R. Pryor, edited by B. Daydon Jackson), but I much doubt this record, neither author or editor put a ! to it.

In Kent it occurs in woods, not in marshes as in Norfolk. In Koch's 'Synopsis of the German and Swiss Flora' its habitat is given as "in sylvis umbrosis." In N. America in "dry woods," while another species, *P. uliginosa*, Torrey, is found in bogs and marshes; in the 'Flora of Schleswig-Holstein,' by Dr. Prahl (1890), it is given from "Turf-moors, but oftener in woods." In Scotland it grows "on moist rocks and woods." In the station near Heigham Sounds it grows in very wet ground, and in drier on the hillocks in the marsh; close by *Cladium mariscus* is growing in twelve inches of water. In Britain we have so little data as to groupings of plants (except the work commenced by the late Mr. Smith in Scotland) that we have no means of comparing what species grows with it in other counties.

The earliest record for Suffolk seems to be 1800. Meadows at Gorleston and Bradwell Common among the furze, Lilly Wigg; but Sir J. E. Smith says it was extinct here in 1828.

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Sir J. E. Smith recorded it from "a Wood at Middleton," and Hooker (1830) says a Mr. D. E. Davy found it there.

Henslow and Skepper (Fl. Suff., 53, 1860) give Ashen Spring near the Roundhouse, Theberton. The Rev. Dr. Hind in his Fl. Suff., 232, 1899, gives these stations, but no intimation that he had ever seen it, and this I know was so, by letters received while he was compiling the Flora. Specimens from Suffolk are in the British Museum Herbarium. In Norfolk the first record I can find is that of Larlingford, Rev. G. R. Leathes in Hooker's Brit. Flora, 192, 1835. The Rev. K. Trimmer gives the station for P. minor with the reference "H. A. B. F." *i.e.*, Hooker and Arnott Brit. Fl., ed. 6, 276, 1860; but they have no such locality under minor, no doubt he intended to quote it under *rotundifolia*. But it was known to R. Wigham at Upton before this, as he records it in MS. in a copy of Sir J. E. Smith's Fl. Brittanica, 1800, formerly in the possession of the late Rev. K. Trimmer, and Paget Nat. Hist. of Yarmouth, 1834, remarks "Bradwell Common, but now lost, but still at Upton, fifteen or twenty miles off." It still grows there as the late Mr. Geldart and Mr. Southwell found it on July 16, 1886 (Trans. 1886, p. 258). In 1866 Mr. Trimmer records it from Gunton on his own authority; and from Bawsey, on the authority of Mr. J. Balding. Mr. Geldart (Trans. 1875) gives it from Roydon Common, on the authority of Dr. Lowe. In 1884, Mr. Trimmer (Supp. Fl. Norfolk, 28) adds Edgefield, Aug., 1873; Felthorpe, July, 1876; and Gressinghall, Aug., 1877, as stations for it.

About 1890, Mr. and Mrs. Cotton found it in abundance near Heigham Sounds by the Meadow Dike, and sent me specimens. In Aug. 1900, and June 1902, my wife and I saw it there in plenty. Near to it grew *Lastrea cristata*, *uliginosa*, and *spinulosa*, the two last on the raised hillocks on the marsh on which the small Willows grow, while *cristata* in the wettest part flourishes.

In June, 1902, my friend Mr. C. E. Salmon found it at Thurne, where it grows with *Carex limosa* and *teretiuscula*, *Peucedanum palustre*, *Liparis Loeselii*, and other marsh plants, a rich little spot.

We have now ten stations in Norfolk, six being in E. Norfolk, and four in W. Norfolk. It will probably be found in other places if sought for, and I should be very glad to hear of any such.

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VII.

A LIST OF PLANTS GATHERED ON A SMALL STRIP OF THE NORTH COAST OF NORFOLK IN THE YEAR 1902.

By the Rev. W. E. Thompson, M.A.

(Communicated through the Hon. Sec.)

Read 27th January, 1903.

The above mentioned district is in V.C. 28, and is the most northerly part of the Norfolk coast. It has a length of about eight miles coast line, from the Hunstanton links to the Brancaster links inclusive, and a breadth of about three miles inland. It comprises the parishes of Titchwell, Thornham, and Holme, and the adjoining borders of the parishes of Brancaster, Ringstead and Hunstanton; all being on the coast except Ringstead. This small strip of country therefore presents great variety of surface, consisting as it does of three different parallel tracts running due east and west; namely, on the north the sand dunes bordering the sea; then the marshes; and inland the southern portion of cultivated land with its villages, gardens, fields, hedgerows, copses, lanes and roads.

From the marshes the ground rises inland to a height of from 150 to 180 feet, at the southern limit of the district here included.

The marsh tract is about three quarters of a mile wide, and consists of alternate salt and fresh water marshes. The Brancaster and Thornham marshes are almost entirely salt, and under water at high tides. The marshes of Titchwell and Holme are, on the landward side of the dunes, entirely fresh water, being land reclaimed from the sea, and intersected by numerous dykes and ditches, which carry off the spring and surface waters to the sea;

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these so called marshes are in fact, dry, firm, grazing land, affording excellent pasture, and an abundant supply of mushrooms in season; while the numerous banks by which they are protected from the tides offer a variety of slope and aspect for many plants. Each of these marshes has some extent of fresh running pools which give harbour to many wild fowl. A pair of Sheldrake brought up a family on the Holme marsh this season. The landward side of the sand dunes, with its southern slope, deep rich moist subsoil and sandy surface, is a perfect garden for flowers, and almost every plant that finds a home there spreads and blooms in profusion from end to end.

Perhaps the most varied and interesting portion of this district is the parish of Holme; its fresh water marsh is more extensive; though the beauty and fertility of its pasture has lately been twice spoilt by incursions of the sea; its sand dunes are larger and more diversified, and it has besides considerable tracts of salt marshes on the seaward side of its dunes, one of which marshes becomes in its season one large oval lake of violet bloom of the *Statice limonium*, many acres in extent.

It is remarkable that in this year, 1902, which has generally seemed so dull, cold, wet, and windy, and unpleasant, the growth, bloom and fruit of all wild plants have been unusually fine and plentiful; while the cultivated crops of hay, corn, and roots, have in this district been above the average both in quantity and quality; indeed some of the barley has been amongst the best ever placed on the market.

The following list is a selection only of some of the plants which have come under my observation during a year's botanising; unless otherwise stated, the nomenclature is that of the London Catalogue, 9th ed.

For economy of space names of orders are generally omitted.

THALICTRUM FLAVUM, Linn. Rare, on banks of ditches, Titchwell marsh. With regard to a variety, *T. sphærocarpum*, Lej., in the ripe panicles gathered here, whilst most of the achenes were small and narrow, several were often large and spherical as if formed by absorption of several into one fruit, which was also 8—10 ribbed.

RANUNCULUS TRICHOPHYLLUS, Chaix. Thornham freshwater marsh.

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RANUNCULUS CIRCINNATUS, Sibth. Thornham and Titchwell marshes; abundant.

,, SCELERATUS, Linn. Thornham and Titchwell marshes; common.

PAPAVER ARGEMONE, Linn. Hedge banks, Brancaster, and Thornham; occasional.

,, HYBRIDUM, Linn. Hedge banks, Brancaster; occasional.

GLAUCIUM FLAVUM, Crantz. Abundant on shore between Hunstanton and Heacham, just outside this district.

CHELIDONIUM MAJUS, Linn. Occasional.

ARABIS HIRSUTA, Scop. (*Turritis hirsuta*, Linn). Chalk pits, banks.

EROPHILA VULGARIS, D.C. Mentioned on account of the wonderful abundance in which this first of flowers overspreads this district wherever it can grow; sand dunes, walls, roadsides, &c.

COCHLEARIA ANGLICA, Linn. Abundant.

SISYMBRIUM SOPHIA, Linn. Banks, Brancaster, and abundant in one spot at Choseley, S. end of Titchwell parish.

ERYSIMUM CHEIRANTHOIDES, Linn. Locally abundant on arable land, Thornham and Titchwell.

CORONOPUS RUELLII, All. Abundant everywhere.

LEPIDIUM RUDERALE, Linn. Abundant along Thornham sea bank.

,, DRABA, Linn. One spot near the windmill, Thornham.

CAKILE MARITIMA, Scop. Occasional along the coast.

RESEDA LUTEOLA, Linn. Common; grows to over six feet high.

,, LUTEA, Linn. Common.

FRANKENIA LÆVIS, Linn. Abundant on Holme and Brancaster salt marshes. In exceptionally fine flower this year. In 'The Students' Flora' Hooker gives Yarmouth as the most northern station for this plant.

SAPONARIA OFFICINALIS, Linn. Hunstanton links.

SILENE MARITIMA, With. Frequent.

,, ANGLICA, Linn. Very abundant in some arable fields, Thornham.

,, NOCTIFLORA, Linn. Abundant.

CERASTIUM TETRANDRUM, Curtis. Plentiful on Titchwell dunes, and doubtless frequent elsewhere.

,, SEMIDECANDRUM, Linn. Abundant all along the coast, and the earliest flower after Erophila.

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CERASTIUM ARVENSE, Linn. Abundant inland especially on high ground, banks, rough roadsides, &c. This plant here takes the place occupied in the West of England by *Stellaria holostea*, and to the casual observer has much the same appearance. *Stell. holost.* does not grow in this district, nor have I ever seen *C. arvense* in West England.

STELLARIA GRAMINEA, Linn. Locally abundant in same positions as the last, Thornham heath, &c.

ARENARIA TENUIFOLIA, Linn. Thornham and Titchwell chalk-quarries; plentiful in one spot in the former place.

„ var. LAXA, Jord. On a wall in Thornham village; in these specimens, 5 stamens, calyx with glandular hairs (not regular in position, and sometimes wanting); capsule often twice the length of calyx, but sometimes the sepals appear to grow equal to it after ripening and opening.

SAGINA MARITIMA, Don. Abundant on Titchwell dunes.

„ NODOSA, Fenzl. Abundant along the coast.

BUDA MEDIA, Dum. Most abundant.

HYPERICUM PERFORATUM, Linn. Frequent.

„ QUADRATUM, Stokes. (*H. tetrapterum*, Fries). Ditch banks on Titchwell marsh, plentiful.

MALVA ROTUNDIFOLIA, Linn. Locally abundant; always at foot of some wall or building.

LINUM ANGUSTIFOLIUM, Huds. Abundant on sea-bank of Titchwell marsh. In the 'Students' Flora' Hooker appears to confine this plant to West England.

GERANIUM PUSILLUM, Linn. Locally abundant, especially on banks near Thornham village. I have found this rare in West England.

„ DISSECTUM, Linn. Frequent and very fine on sea-banks, Thornham.

EUONYMUS EUROPÆUS, Linn. Copse, Thornham heath.

ONONIS REPENS, Linn. Frequent.

TRIFOLIUM SUBTERRANEUM, Linn. A considerable quantity of this interesting plant on the sea-bank of Titchwell marsh. It flowers early in May. The heads consist of three to five perfect flowers. When the flowers fade the peduncles begin to bend down to

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the soil, at the same time the individual flowers with their pedicels also reflex, which brings them upright as the stem bends downwards; at the same time also from the apex of the floral axis at the base of the pedicels singular organs begin to develope which I would term calyx-radicles; these develope, several in succession, from the recurved apex of the stem, first downwards into the soil, then curving laterally and finally upwards, so without doubt helping to bury the pods in the ground and retain them there; the stiff spreading lobes which terminate each of the calyx-radicles acting like claws. Any plant will show all stages at once from the opening flowers to the buried pods, as soon as the burying process has begun. Many descriptions of this singular flower appear to me misleading. In 'The Student's Flora' Hooker writes, "Pods burrowing in the earth, then covered by the reflexed deformed calyces of the other flowers"!! A most strange statement. There are no other flowers, and the three to five flowers of which alone the head consists have withered before the so-called "deformed calyces" even begin to develop. Here is evidently an example of the numerous errors which appear in books on botany, due to the use of dried specimens uncorrected by the additional use of the living book of nature. It is true that dried specimens do show what appears to be several deformed calyces covering the fruit. But then the calyx-radicles are attenuated and withered, and their history lost. Another book terms them "abortive calyces;" and both give the false impression that the *original heads* consist of these deformed or abortive calyces in addition to the perfect flowers.

TRIFOLIUM OCHROLEUCON, Huds. A bed of this on bank of Brancaster fresh-water marsh.

„ STRIATUM, Linn. Abundant on sea-bank, Titchwell marsh.

„ FRAGIFERUM, Linn. Brancaster fresh-water marsh.

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ANTHYLLIS VULNERARIA, Linn. Abundant.

VICIA ANGUSTIFOLIA var. BOBARTII. Titchwell marsh.

PRUNUS PADUS, Linn. Several in copse on Thornham heath.

SPIRÆA FILIPENDULA, Linn. Abundant on Thornham heath and neighbouring lanes.

ROSA RUBIGINOSA, Linn. Frequent; diffusing a delightful odour for many yards round it as soon as the young leaves appear in March.

SAXIFRAGA TRIDACTYLITES, Linn. Abundant on walls, Thornham, &c.

MYRIOPHYLLUM SPICATUM, Linn. Ditches, Titchwell marsh.

BRYONIA DIOICA, Jacq. Plentiful.

ERYNGIUM MARITIMUM, Linn. Occasional along coast.

CONIUM MACULATUM, Linn. Road-sides, Holme; not common.

SMYRNIUM OLUSATRUM, Linn. Most abundant in hedgerows and copses from Hunstanton to Thornham within mile of sea.

BUPLEURUM TENUISSIMUM, Linn. Locally abundant on banks and waste ground on Titchwell and Thornham marshes, near the sea.

APIUM GRAVEOLENS, Linn. Abundant on the marshes.

CARUM SEGETUM, Benth. and Hook. fil. In quantity on one or two positions on banks of Holme and Thornham marshes.

SIUM LATIFOLIUM, Linn. Thornham marsh.

SCANDIX PECTEN-VENERIS, Linn. Locally abundant. Titchwell and occasional at Thornham.

ANTHRISCUS VULGARIS, Bernh. Occasional in some quantity.

FŒNICULUM VULGARE, Mill. Frequent.

ŒNANTHE LACHENALII, C. Gmel. Holme marsh.

,, FISTULOSA, Linn. Holme marsh.

PEUCEDANUM SATIVUM, Benth & H. Common.

CAUCALIS NODOSA, Scop. Abundant, banks Titchwell marsh.

GALIUM ULIGINOSUM, Linn. In bog on Titchwell marsh. In S.W. corner of Titchwell marsh is the only bit of genuine peat bog in this district which I have noticed; several plants hereafter referred to it.

DIPSACUS SYLVESTRIS, Huds. Frequent.

SCABIOSA COLUMBARIA, and ARVENSIS, L. Common.

EUPATORIUM CANNABINUM, Linn. Titchwell marsh.

ASTER TRIPOLIUM, L. Abundant.

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ERIGERON ACRE, Linn. Frequent along the sand dunes.

„ CANADENSE, Linn. *One plant* on the Hunstanton links, on *wet* ground. I also gathered one solitary plant of this in a sand quarry at Ryburgh in this county in 1896. Strange that a plant which blooms and seeds so freely should be so rare, and then only in solitary specimens.

FILAGO GERMANICA, Linn. Abundant on fallow land, and especially fine this year at Thornham Lyng.

„ MINIMA, Fries. In considerable patches on the Holme dunes.

PULICARIS DYSENTERICA, Gærtn. Ditch sides, frequent.

ARTEMISIA VULGARIS, Linn. Frequent and very fine. Titchwell, &c.

„ MARITIMA, Linn. Most abundant, strongly and deliciously aromatic.

„ GALLICA, Willd. Plentiful on Thornham marsh. This is now recognised as a separate and well marked species; leaves habit and facies well differentiate.

SENECIO SYLVATICUS, L. Banks on Titchwell marsh, inland.

„ ERUCIFOLIUS, L. Banks, Titchwell and Thornham marshes.

CARLINA VULGARIS, L. Frequent inland.

CARDUUS NUTANS, L. Frequent inland.

CNICUS ACAULIS, Willd. Thornham heath.

CICHORIUM INTYBUS, L. Occasional.

PICRIS ECHIOIDES, L. Ditch banks, Titchwell marsh, east end. Said to be common, but I have only found this plant in three places, each near the sea, viz., on Ormes Head above the Irish Sea, on Downs near Dartmouth above the Channel, and here on this coast.

CREPIS TARAXACIFOLIA, Thuill. Hunstanton cliffs.

LACTUCA VIROSA, Linn. Abundant on the Hunstanton links.

TRAGOPOGON PRATENSIS, L. Occasional.

STATICE LIMONIUM, L. Grows in mud and flowers last.

„ AURICULÆFOLIA, Vahl. Grows on edge of mud, outside, flowers second.

„ RETICULATA, Linn. Grows on drier ground and flowers first. All three abundant and growing near one another on the salt marshes: Holme, Thornham, Titchwell, Brancaster.

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PRIMULA ACAULIS, L. Rare. Copse, Titchwell; side of pool, Ringstead.
„ VERIS, L. Occasional on turf.
GLAUX MARITIMA, L. In extensive patches along Holme dunes, on lower landward side, and elsewhere along coast.
ANAGALLIS TENELLA, Linn. Bog on Titchwell marsh.
SAMOLUS VALERANDI, L. Frequent.
ERYTHRÆA PULCHELLA, Fries. Wet ground on Hunstanton links, flower buds often yellow.
MENYANTHES TRIFOLIATA, L. Titchwell marsh.
CYNOGLOSSUM OFFICINALE, Linn. All along dunes, abundant.
SYMPHYTUM ASPERRIMUM, Brit. One clump on the Holme dunes amongst some pines; probably introduced with soil when they were planted.
LYCOPSIS ARVENSIS, L. Frequent.
LITHOSPERMUM OFFICINALE, L. Chalk quarry, Holme.
ECHIUM VULGARE, L. Common.
VOLVULUS SOLDANELLA, Junger. All along dunes; abundant.
SOLANUM DULCAMARA, Linn. Frequent on coast and inland.
„ NIGRUM, L. On Hunstanton shore; Holme dunes.
PLANTAGO, L. All five Plantains, common.
VERBASCUM PULVERULENTUM, Vill. Very occasional; Brancaster dunes, and Thornham and Ringstead, inland.
VERONICA POLITA, Fries. Thornham roadside; occasional.
OROBANCHE MINOR, Sm. Plentiful in clover-fields. In one field just above Thornham village, this year in July, this plant was so excessive as to colour the field; the colour of the plants ranged from a dirty purple-tinged yellow to a bright pure golden yellow.
VERBENA OFFICINALIS, Linn. Occasional.
MENTHA ROTUNDIFOLIA, Huds. One spot, roadside, Thornham.
LYCOPUS EUROPÆUS, L. Titchwell marsh, ditch banks.
CALAMINTHA OFFICINALIS, Mænch. Rare, on Holme dunes.
„ ACINOS, Clairv, (? London Catalogue) abundant inland in Thornham parish especially at Thornham Lyng.
SALVIA VERBENACA, L. Frequent on dry banks.
NEPETA CATARIA, Linn. Frequent, especially at Thornham Lyng.
MARRUBIUM VULGARE, L. Frequent, abundant at Thornham Lyng.
BALLOTA NIGRA, L. Abundant.
BETA MARITIMA, L. Hunstanton shore.
ATRIPLEX LITTORALIS, L. Plentiful, Titchwell, Thornham.

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ATRIPLEX PATULA and HASTATA, L. Common.

,, PORTULACOIDES, L. Most abundant.

SALICORNIA HERBACEA, L. In enormous beds.

,, RADICANS, Sm. Common.

,, ADPRESSA, Dum. Occasional with the two last on the Thornham and Titchwell coast. A small plant, with few branches *closely pressed* to the ground in *a fan-shaped manner*. I have not had this authenticated however, and do not know it from var. *procumbens of S. herbacea;* but the term "procumbens" seems scarcely suitable to this. This remark is added because only one county is assigned to this plant in the London Catalogue, and that, I believe, is Kent.

SUÆDA MARITIMA, Dum. Common.

,, FRUTICOSA, Forsk. Abundant.

SALSOLA KALI, L. Frequent.

PARIETARIA OFFICINALIS, L. Abundant locally.

CERATOPHYLLUM DEMERSUM, L. Freshwater ditches, Bran marsh.

HYDROCHARIS MORSUS-RANÆ, L. In extensive abundance, filling many hundred yards of ditches on Brancaster fresh water marsh, but showing very few flowers.

ELODEA CANADENSIS, Michx. Occasional.

LISTERA OVATA, R. Br. Titchwell marsh.

SPIRANTHES AUTUMNALIS, Rich. Locally abundant, Ringstead Park.

ORCHIS PYRAMIDALIS, L. Titchwell chalk quarry, &c., occasional.

,, MORIO, L. Titchwell marsh.

,, LATIFOLIA, L. Titchwell marsh; from six inches to three feet high.

,, MACULATA, L. Titchwell marsh.

JUNCUS BUFONIUS, L. Occasional, Titchwell marsh.

,, GERARDI, Loisel. Abundant in considerable beds.

,, MARITIMUS, L. Abundant.

,, ACUTUS, L. A few clumps on Brancaster marsh; in fruit when *maritimus* is beginning to flower.

,, EFFUSUS, L. Abundant: *J. acutiflorus*, Ehrh; occasional.

TYPHA LATIFOLIA, L. Occasional, Titchwell and Thornham marshes.

,, ANGUSTIFOLIA, L. Plentiful, Titchwell and Thornham marshes.

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SPARGANIUM RAMOSUM, Huds. Common, Titchwell marsh.
„ SIMPLEX, Hudson. Plentiful, same place.
LEMNA GIBBA, L. In flower, ditches, Titchwell.
ALISMA PLANTAGO, L. Frequent.
BUTOMUS UMBELLATUS, L. Thornham fresh marsh.
SAGITTARIA SAGITTIFOLIA, L. Brancaster marsh, plentiful.
TRIGLOCHIN PALUSTRE, L. Occasional.
„ MARITIMUM, L. Abundant.
POTAMOGETON NATANS, L. *densus*, L: *pusillus*, L. Occasional.
„ PECTINATUS, L. Abundant on Holme marsh.
ZANNICHELLIA PEDUNCULATA, Reichb. Entangled with *Potamogeton pusillus* in ditches, Brancaster and Titchwell marshes, and in good fruit.

CYPERACEÆ.

ELEOCHARIS PALUSTRIS, R. Br. Titchwell and Thornham marshes.
SCIRPUS TABERNÆMONTANI, Gmel. Titchwell and Thornham; abundant.
„ MARITIMUS, L. Abundant.
„ SETACEUS, L. In bog on Titchwell marsh.
ERIOPHORON (POLYSTACHION, L.). ANGUSTIFOLIUM, Roth. In bog on Titchwell marsh.
CAREX PULICARIS. L. In bog on Titchwell marsh.
„ DIVISA, Huds. Holme marsh, plentiful in one spot.
„ ARENARIA, L. Abundant.
„ DIVULSA, Good. Frequent.
„ VULPINA, L. Frequent.
„ MURICATA, L. Banks inland; frequent.
„ ECHINATA, Murr. In bog on Titchwell marsh.
„ OVALIS, Good. Holme marsh with *C. divisa*.
„ GOODENOVII, Gay. Occasional.
„ GLAUCA, Murr. (? London Catalogue) frequent.
„ PANICEA, L. Frequent.
„ PRÆCOX, Jacq. (? London Catalogue) common.
„ DISTANS, L. Abundant.
„ FLAVA, L. Titchwell marsh in bog.
„ EXTENSA, Good. Hunstanton and Holme marshes, abundant.
„ HIRTA, L. Frequent.
„ RIPARIA, Curtis. Abundant.

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GRAMINEÆ.

PHLEUM ARENARIUM, L. Titchwell dunes.
AGROSTIS PALUSTRIS, Huds. Titchwell marsh.
AMMOPHILA ARUNDINACEA, Host. Abundant all over the dunes.
SIEGLINGIA DECUMBENS, Bernh. One spot on Titchwell marsh.
PHRAGMITES COMMUNIS, Trin. Abundant.
CATABROSA AQUATICA, Beauv. Titchwell and Brancaster marshes.
POA PRATENSIS, var. SUBCÆRULEA, Lin. Abundant on the dunes.
GLYCERIA FLUITANS, R. Br. Frequent.
,, AQUATICA, Sm. Ditches on Thornham marsh.
,, MARITIMA, Mert. & Koch. Abundant.
,, DISTANS, Wahl. Plentiful on Holme marsh; Titchwell occasional.
,, BORRERI, Bab. Frequent on Holme marsh; Titchwell; one spot.
FESTUCA RUBRA, L. Abundant along the dunes.
AGROPYRON PYCNANTHUM, Gr. & Godr. Titchwell marsh on [illegible] of ditches at foot of the sand dunes. glaucous, spike compact.
,, JUNCEUM, Beauv. Plentiful.
LEPTURUS FILIFORMIS, Trin. Most abundant.
HORDEUM SECALINUM, Schreb. Brancaster marsh.
,, MURINUM, L. Abundant.
,, MARINUM, Huds. Plentiful.
ELYMUS ARENARIUS, Linn. Locally abundant on the dunes.

FILICES.

A note on these merely to express some wonder at finding any at all, where such as do occur are so very few and far between, and often deformed and pauperised.

ASPLENIUM TRICHOMANES, L. A bed of this, about 10 ft. by 1 ft. broad, running down the east wall of the porch of Thornham Church, being in fact exactly coextensive with the drip of the gargoyle.
,, RUTA-MURARIA, L. One or two solitary samples.
SCOLOPENDORUIM VULGARE, Symons. Occasional dwarfed and distorted samples on shady damp stone work.
NEPHRODIUM SPINULOSUM, Desv., (*Lastrea spinosa*, Newman), however flourishes well in one place in Titchwell parish.

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Fungi.

TULOSTOMA MAMMOSUM, Fries. This very rare fungus occurs on two positions within a few yards of each other amongst a small pine plantation on the Holme sand dunes; in the one place were a dozen, in the other a couple of score or more. This fungus is like a small puff ball on the top of a stem; the stem is buried to the top in its sandy bed; the orifice of the ball is a clean cut nipple. Entire length, 1½ to two inches, of which the ball is about ⅜ inch. February, and again in December.

CANTHARELLUS TREMULUS, Schæff. Also somewhat rare, in the same part of Holme dunes, in October; plentiful as a parasite on the moss *Tortula ruraliformis*.

MARASMIUS ROTULA, Fries. Very common in same place as a parasite on the base of grass stems just where they leave the soil. October.

MORCHELLA ESCULENTA, L. Fine specimens in lane near Thornham vicarage; spring.

There is some variety and abundance of common fungi over the dunes and marshes.

Mosses.

I have gathered some eighty different Mosses in this district These give forty-seven additions to the moss list for this vice-county, including fifteen to the county list, of which two are also new to the British Flora.

On the Hunstanton links it was my good fortune to find, in some quantity and with abundant fruit, a new *Bryum*.

BRYUM MAMILLATUM, Lindb. Which has, I understand, only been found before on one or two positions on the shores of the Baltic. And on the seaward slope of the Holme dunes I found a considerable bed of a Bryum, with abundant fruit, which experts consider a new variety of the common *B. cæspiticium*.

This moss list will be incorporated by Mr. H. N. Dixon, F.L.S., with his supplementary list for the county.

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VIII.

ENTOMOLOGICAL NOTES FOR 1902.

By W. H. Tuck, M.A.

Read 27th January, 1903.

The weather all the collecting season was very broken and varied, but I managed to get through a good lot of field work, my chief occupation being the somewhat neglected groups of water insects. Starting with the Aculeate-Hymenoptera as usual, I record a new Wasp for Britain, *Odynerus bifasciatus*, Linn. I took specimens of both sexes as long back as June 1895 and 1897, but Mr. Edward Saunders has only recently identified them, as they were mixed up with a large colony of *Odynerus sinuatus*, to which they bear a striking resemblance. This brings the list of Suffolk Wasps to 17.

At Cromer, in August, I found the large Ant, Formica fusca in plenty, together with the winged sexes of another, Lasius umbratus, which does not appear in Mr. Bridgman's list. The next day, August 16th, being very fine and sunny, I took two females of Tiphia femorata upon Wild Carrot (*Daucus carota*) in the same locality that the late F. Smith found it twenty-five years ago.

Close to the old Station, I took a scarce Bee, Andrena nigriceps, together with its parasite, Nomada jacobææ, which were flying around its burrows and entering them. At Plumstead Lake, on June 7th, I took on Hawthorn bloom a male Bee, new to Norfolk, *Andrena ambigua*, which I have twice before taken at Tostock.

I added ten Beetles to the list for Suffolk, published by Claude Morley in 1899; of these Homalota ravilla and Quedius obliteratus were both in an old nest of Vespa vulgaris, which I opened March 13th. I understand that the obscure genus of "Quedius" in Coleoptera still needs much revision.

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The waters supplied me with the other eight novelties. The best thing, Dytiscus circumcinctus, a fen species, I took in a ditch at Tostock, May 23rd, a dimorphic female with the elytra of the male.

Rhantus grapii and bistriatus, Cercyon terminatus, Hydroporus discretus, Helophorus mulsanti, were the novelties which the other home waters yielded; while at Bungay I got Dytiscus punctulatus and Doronectes depressus, the latter in plenty by dredging a tributary stream of the Waveney in the town. Other notable captures in water were: Copelatus agilis, Agabus paludosus and sturmi, Cælambus confluens, Hydroporus memnonius, Haliplus fluviatilis and Bagous alismatis; the last two at Bungay. At Brundall, in Dr. Beverley's garden, I took two brilliant specimens of Donacia dentipes, and by Plumstead Lake the same day (June 7th) Anaspis flava on Hawthorn bloom.

At Ditchingham, the next week, I found Mordellistena brunnea upon Ragwort, and upon Hazel by the Bath Hills, the curious Weevil, Balaninus turbatus. The only Sawfly of note at Bungay was Tenthredopsis coqueberti, where I also found two rather local Hemiptera, Megalocera longicornis and Plagiognathus roseri. The fine Ranatra linearis I took twice at Tostock both in deep and shallow water. The fungi were rather abundant and very early in appearing, but the only good thing I obtained was Cis nitidus, from a beech fungus.

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IX.

METEOROLOGICAL NOTES, 1902.

(From observations taken at Bradestone House, Brundall, Norfolk.)

By Arthur W. Preston, F. R. Met. Soc.

Read 24th February, 1903.

January.

The month was exceedingly mild up to the 24th, maxima of over 50 degrees were recorded on eight days. There was but little frost till the last week, when the weather was of a winterly type, with snow. The mean temperature of the month was 3 degrees above the average, and the rainfall, .71 ins. deficient. Between the 4th and 24th, the falls of rain were very trifling.

February.

Unbroken cold weather prevailed to the 22nd, without one mild day, and many of the nights were as cold as in some of the severest of our winters. On the 16th the screened thermometer fell to 14 degrees, the reading by the exposed instrument having been as low as 7.8 degrees. Although these readings fell far short of the minimum of the 14th February, 1901 (9.2 degrees and 5.8 degrees respectively), they were, nevertheless with that single exception, lower than any recorded in February since 1895. The hard frost gave several days sport to the skaters, good ice being found on the marshes. The rainfall of the month was greatly deficient, the total having been less than half the average. Snow in small quantities fell on five days, but it was sufficient to impart a wintry aspect to the country, and remained on the ground about ten days.

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March.

The month was more genial than for several years past, and although no day was exceptionally warm for the season, there were a great many moderately mild days which kept the mean temperature high. The rainfall was .65 deficient, and there was no snow. Thunder occurred on the 21st.

April.

The second week was very cold, the mean temperature being as low as 40.9 degrees. Between the 5th and 12th, the thermometer did not once touch 50 degrees. Milder weather followed in the third week, but the last week was again exceedingly cold. With the exception of .80 of rain which fell on the 5th, and which was accompanied by thunder, the falls of rain during the month were exceedingly trifling.

May.

So cold, wet and ungenial a May has not been recorded for many years, notwithstanding the capricious character of the month in many seasons, particularly of late. Down to the 23rd day the thermometer readings were so persistently low that it was difficult to realize that May had come, and the coldness was accompanied by much wet weather, rain having been recorded on 22 consecutive days. Snow fell on the 5th, 12th and 13th, and frost occurred on the grass on no less than twelve nights. The last week was more genial, but, on the mean, the month was the coldest May since 1887, and the wettest since 1878.

June.

The first half of the month was cold, wet and ungenial, and attended by much thunder in the earlier days. A severe thunderstorm which commenced about 10 p.m. on May 31st, continued till about 2 a.m., on June 1st, accompanied by heavy rain, and very vivid lightning. The thermometer did not touch 60 degrees between the 5th and 12th, and on the nights of the 9th and 10th, fell to 39.2 degrees and 36.3 degrees respectively in the screen, and to 32.6 degrees and 32.5 degrees on the grass. The last ten

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days of the month were very warm and bright, the temperature reaching 80.2 degrees on the 30th.

JULY.

This month was less warm and more cloudy than for several years past, but the rainfall was three quarters of an inch below the average. The thermometer only once rose above 80 degrees (viz., 83.4 degrees on the 15th), and some of the nights were unseasonably cold, notably the 3rd and 12th, the minimum on which occasions having been as low as 40.6 degrees and 41 degrees respectively in the screen, and 36.5 degrees and 35 degrees on the grass. Strong winds occurred on the 27th during the passage of a cyclonic disturbance from the South-west of Ireland to Norway.

AUGUST.

On the mean, this was the coldest August since 1888. There were no days of excessive heat, and in the first week there were some unseasonably cold nights. The prevalence of cloud kept down the temperature on many days, and the month presented a great contrast to the hot and dry August of the previous year. The rainfall was an inch above the average, but fell considerably short of the heavy fall of August 1900.

SEPTEMBER.

On the whole, this was a very fine month, though some of the mornings were chilly, and, during the second week, there was a considerable amount of cloud. Some fine, dry days in the latter part of the month enabled the farmers to complete the harvest which had been considerably delayed by the cool and broken weather of August. The rainfall of the month was only about half the average, and it nearly all fell on the 2nd and 11th. After the 12th the month was almost rainless.

OCTOBER.

This was rather a cloudy and humid month, but although rain was registered on twenty-three days the amounts were generally small, and the total for the month was less than half the mean.

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Temperature was in close agreement with the average, but absence of frost kept garden flowers, particularly roses and dahlias, in bloom most luxuriantly to a much later period than usual.

November.

The first fortnight was exceedingly mild, the mean of the period having been about 5 degrees above the average, and 4.7 degrees higher than that of the first fortnight of the previous May! An abrupt change to cold took place on the 16th followed by milder weather at the month's close. There were no particularly sharp frosts during the month, although the East wind accompanying the cold weather of third week killed many of the more delicate of the garden flowers. The mildness of the earlier days of the month resulted in good dishes of peas being gathered from the garden as late as the 14th, five days later than I ever recollect having had them from the open. Rain fell on ten days only—a rare occurrence in November—and in the third week the roads were as dry and dusty as in March.

December.

The month at first promised to be a cold one, the day readings of the earlier part of the month having been persistently low. The easterly winds and gales of this period, accompanied as they were on some days, by snow, made the meteorological conditions exceedingly uncomfortable. The rainfall was deficient, for the fourth month in succession. During Christmas week the weather was exceedingly fine, mild and spring-like, with a remarkable absence of frost.

The Seasons.

The following Tables show the mean temperature and rainfall of the four seasons, together with those of the five previous years, compared, as to temperature, with the average of the twenty years 1883—1902, and as to rainfall with the 38-year average mentioned below. Winter comprises the three months, December to February inclusive; Spring, March to May; Summer, June to August; and Autumn, September to November.

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TEMPERATURE.

Seasons.	1897.	1898.	1899.	1900.	1901.	1902.	38-year average 1863—92.	Departure of 1897 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	38.3	41.3	42.6	37.4	39.0	37.9	38.0	— 0.1
Spring ...	46.9	45.8	46.2	45.3	46.3	46.3	46.3	0.0
Summer ...	61.9	59.7	61.9	61.6	61.4	58.7	60.3	— 1.6
Autumn ...	50.3	54.0	51.2	51.6	50.7	50.1	50.2	— 0.1
Year	49.5	50.5	49.8	49.6	48.8	48.4	48.7	—0.3

RAINFALL.

Seasons.	1897.	1898.	1899.	1900.	1901.	1902.	38-year average 1865—92.	Departure of 1902 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	7.86	4.11	5.82	7.42	5.88	6.09	5.96	+0.13
Spring ...	5.05	6.18	6.84	4.26	5.10	6.77	5.27	+1.50
Summer ...	4.17	6.90	3.52	8.77	3.61	7.82	6.94	+0.88
Autumn ...	6.42	5.65	8.31	5.32	5.11	4.14	8.01	—3.87
Year ...	22.07	23.33	23.94	26.99	21.06	22.30	26.18	— 3.88

It will be observed from the foregoing that, with the exception of the summer, which was about one and a half degree below the average, each of the seasons gave about normal temperature, the severity of February counterbalancing the mildness of January, and the coldness of May proving a set-off to the warmth of March. As to the rainfall, that of the winter was of normal amount, the spring (through the wet May) excessive, and the summer slightly in excess, whereas the autumn yielded but little more than half the usual amount.

The Year.

The special feature of the year was the unusually cold spring (in the latter part), and the exceptionally wet May. Although the summer was cool and humid, with a conspicuous absence of hot days, the rainfall was not much above the average, and there were intervals of fine weather at times. The year's rainfall was nearly four inches deficient, and, following as it does, so many dry years, the want of water was much felt in the late autumn and early winter. A really rainy year has not been experienced since 1892, and in seven out of the last ten years the total rainfall has failed to reach twenty-four inches. Harvest commenced about August 14th.

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Inspection of Station.

This station was inspected on September 2nd by Mr. W. Marriott, F. R. Met. Soc., Assistant Secretary and Inspector of Stations for the Society. The instruments were all found to be in proper working order, and Mr. Marriott expressed his satisfaction at the general arrangements.

General.

Having on the 31st December, 1902, completed twenty years' daily observations of the temperature and rainfall of this district, a brief summary of some of the results obtained may not be altogether out of place.

The highest reading of the thermometer in the shade during the period under review occurred on the 11th August, 1884, when a maximum of 91.0 degrees was recorded. The coldest night was on the 6–7th February, 1895, when the thermometer in the screen fell to 4.0 degrees; on this night the exposed thermometer fell to 3.5 degrees below zero.

The warmest month was August, 1884 (mean temperature 66.1 degrees), and the coldest month was December, 1890 (mean temperature 30.2 degrees).

The warmest year, on the mean, was 1898, averaging 50.5 degrees, and the coldest year was 1888 (46.9 degrees).

The mean temperature of each of the months for the twenty-year period was as follows:—

MEAN TEMPERATURE.

	degrees.
January	37.3
February	38.2
March	40.9
April	46.3
May	51.6
June	58.4
July	61.4
August	61.0
September	57.4
October	49.3
November...	43.8
December...	38.5
Year ...	48.66

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With regard to the rainfall, the largest amount recorded on any day for the twenty-four hours ending 9 a.m. was 2.57 ins. on 13th July, 1889.

The wettest month was October 1892, with a total of 7.62 ins. The driest month was February 1891, when but .07 ins. of moisture was registered.

The wettest year was 1892, the total fall being 31.05 ins. The driest year was 1893, when only 19.66 ins. of rain fell.

The mean monthly falls are given below, but, as from the number of abnormally dry years that occurred during the period the averages are undoubtedly too low to represent the standard values of the district, a further set of averages has been prepared, obtained from adding the previous eighteen years' falls, taken from the register kept at St. Catherine's Close, Norwich, by the late Mrs. Evans. There is no doubt that many of these eighteen previous years were abnormally wet, comprising, as the period does, the rainy years of the late seventies and early eighties, which were doubtless the primary cause of the setting in of the agricultural depression. Taking these unusually wet years as a set-off against the dry ones which occurred during the last ten years, the mean of the thirty-eight years rainfall 1865 to 1902 would appear to fairly represent that of this district.

MEAN RAINFALL.

	Mean of 20 years 1883—1902. ins.	Mean of 38 years 1865—1902. ins.
January	1.90	1.89
February	1.42	1.71
March	1.75	1.74
April	1.57	1.68
May	1.98	1.85
June	1.78	1.90
July	2.61	2.66
August	2.22	2.38
September	2.14	2.47
October	3.04	2.90
November	2.43	2.64
December ...	2.13	2.36
Year ...	24.97	26.18

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1902.

Month.	Barometer.					Thermometer.					Hygrometer.	Cloud.	Rainfall.		Wind.								
	Highest.	Date.	Lowest.	Date.	Mean.	Highest.	Date.	Lowest.	Date.	Mean.	Mean Relative Humidity, 9 a.m.	Estimated proportion	Inches.	No. of days.	Direction.								Mean estimated force
															N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W	
Jan. .	30.82	31	29.14	25	30.116	52.4°	4	25.4°	30	40.5°	88	7.1	1.18	17	2	0	1	1	1	6	10	10	3.5
Feb. .	30.74	1	29.26	27	29.896	54.0	28	14.0	16	34.9	90	6.6	0.77	14	0	3	5	10	1	1	3	5	2.2
March	30.21	16	29.12	24	29.829	60.0	17	26.2	6	43.8	86	7.0	1.07	15	1	0	0	1	4	11	7	7	3.4
April	30.29	7	29.54	1	29.961	65.2	19	29.2	9	46.8	75	5.7	1.31	13	4	4	4	5	3	4	3	3	3.6
May .	30.42	25	29.19	17	29.935	72.8	31	31.2	14	48.2	77	7.6	4.39	25	9	3	0	1	1	3	4	10	3.5
June .	30.32	25	29.37	13	29.935	80.2	30	36.3	11	57.9	79	6.2	2.34	16	4	3	7	5	2	3	5	1	2.9
July .	30.31	2	29.45	26	30.016	83.4	15	40.6	3	59.7	74	6.2	2.11	14	4	1	1	2	2	3	12	6	2.8
Aug. .	30.22	22	29.65	18	29.927	77.8	29	39.8	2	58.4	80	6.8	3.37	18	2	7	2	1	5	6	7	1	2.6
Sept. .	30.48	26	29.63	3	30.079	73.0	3	38.0	19	56.3	82	6.0	1.38	8	5	2	5	4	4	2	4	4	3.1
Oct. .	30.52	24	29.36	16	29.981	65.3	10	35.6	31	50.1	88	7.5	1.34	23	1	0	9	1	6	2	7	5	3.0
Nov. .	30.43	18	29.34	28	29.935	60.8	1	29.0	22	43.9	91	6.8	1.42	10	0	0	8	9	5	5	3	0	3.2
Dec. .	30.58	4	28.89	30	30.030	56.0	16	26.0	4	40.4	89	7.2	1.62	19	1	0	10	1	2	4	8	5	4.0
Means					29.970					48.4	83	6.7											3.1
Extreme & Totals	30.82	Jan. 31st	28.89	Dec. 30th		83.4	July 15th	14.0	Feb. 16th				22.30	192	33	23	52	41	36	50	73	57	

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X.

NOTES ON THE HERRING FISHERY OF 1902.

By T. J. Wigg,

Honorary Secretary Great Yarmouth Section.

Read 24th February, 1903.

In again presenting my notes on the Herring Fishery, I have to chronicle the events of a most unprecedented season. In fact there is so much to talk about that I hardly know where, or how to commence. The change from a holiday-making resort, with the sea-front thronged with visitors, and the streets noisy with the rush of well-filled brakes, to the bustle of the Herring Fishery, cannot fail to impress even the most casual observer. The town reeks of fish and the Herring is in evidence from Wharf to curing houses and railway stations.

If the thousands of people who flock to Yarmouth during the summer months only realised what October would enable them to see, they would certainly wish that their holiday could be extended.

The scene on the Fish Wharf and its surroundings can hardly be described. During my visits to the South Denes I was struck with the vast quantities of all kinds of material required in the preparation of the Herring. Here were piles on piles of barrels, thousands of swills, and there, hundreds of women, chiefly Scotch, at the enormous troughs containing the Herrings to be pickled. Thence I went to the Fish Wharf, where I found that not only was the whole covered market occupied by the "silver beauties," but almost every foot of ground beside the river was covered with "swills" or with barrels full of Herrings, while the scene was quite beyond my powers of description.

The Autumn fishing at Yarmouth began in earnest during the second week in October, and continued without intermission up to December 20th, while a few boats actually worked during Christmas week.

The main features of the fishing have been enormous catches

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and, as a rule, very good prices obtainable. This was owing to the very large export trade, which I shall mention later.

I stated in my notes for 1901, that about 2,000 Scotch girls and women came to Yarmouth for the Herring Fishery. In 1902 this number was doubled, there being altogether about 4,000 of these hardworking women employed at the various fishing premises and on the South Denes plots. Many local men who used to employ Yarmouth people, now give preference to the Scotch girls. Employers in such a business want good, reliable helpers, and these they obtain when they employ the professional gutting lasses from Scotland. The outer dress of these women consists of an oilskin, which covers them from head to foot, and a pair of top boots, similar to those worn by the men. Thus attired, and with their hands bound up with linen bandages to guard against cuts from their sharp knives, they go to their work. The dexterity with which they use their knives is a sight that must be seen to be thoroughly understood. Many of the residents in Yarmouth took a keen interest in the proceedings on the South Denes, and numbers visited the place during the day. In the evening the grounds were illuminated by thousands of lamps, torches and electric lamps, the scene up to ten o'clock being a very animated and remarkable one. Some excitement was created during the earlier part of the season by the arrival in port of several foreign steamers loaded with barrels from Sweden and Norway. The coopers, a most important body of men, protested, and informed their employers that the barrels would not be used by them or the Scotch girls. A compromise was effected and work proceeded. Steamers from Fraserburgh, Aberdeen, and other Scotch ports brought in huge cargoes of barrels which were soon filled for export. With regard to the export trade, expectations formed a few years ago have been more than realised, and at the present time there is a great and firm continental demand for Yarmouth Herrings. Thousands of barrels of salted Herrings were taken by steamers for the Baltic, for use by the Russian and German peasants, while others are taken to the Mediterranean ports for distribution through the countries bordering on that sea.

The following statement appeared in the 'Eastern Daily Press' of January 2nd, 1903:—"In nine years the shipments of Herrings to the Baltic in direct chartered vessels have grown from 16,000

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barrels to over a quarter of a million barrels. Here is expansion on a truly generous scale! And yet these figures only relate to a part of Yarmouth's export Herring trade, for there are thousands of barrels sent away by the Hull and London steamers, while tens of thousands more are hauled away in special trains from Yarmouth to Liverpool for shipment to the Mediterranean, the Levant, and elsewhere. So there is also a big coastwise trade in Herrings of which no note has been taken in the figures quoted. Well may it be said that a single Herring boat is worth to the town far more than a whole row of lodging-houses, since at every turn the handling of the Herring means lucrative employment for labour. The Corporation is now deriving a handsome revenue from the Herring in various ways, and in a short time its splendid Fish Wharf and Market will have been completely paid for. There was more accommodation offered last season for the Herring steamers to load, but the Quay space available for this purpose was not nearly enough to meet the requirements, and before next season comes round there must be a better provision of loading berths, or the trade will be seriously hampered."

The week ending November 15th, 1902, was a record breaker so far as the Herring Fishery is concerned. On the whole the weather had been gloriously fine, fish plentiful, and boats doing very well, but about midnight on Monday, November 10th, a number of steamers reached the harbour, and as they had on board enormous catches of Herrings, varying from fifteen to twenty lasts per boat, the news soon spread, and at a very early hour in the morning of Tuesday it was evident that there was a probability of a busy day. As the morning advanced, boat after boat came in heavily laden, and by noon the unloading was progressing all along the South Quay, as far as the Haven Bridge. Crowds of people were attracted by the extraordinary scene.

At one time there was such a wild scramble of boats to obtain a berth, that the breaking of a rope caused quite a block in the river, so that it was possible for several venturesome people to cross from one side to the other by passing over the boats.

Of course with all this mass of Herrings in swills and barrels, there was bustle everywhere but not confusion, as everybody worked with precision and tact, and soon the huge deliveries were dealt with, and room provided for others. It was estimated that

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the total number landed this day amounted to 4,000 lasts, or 52,800,000 fish, worth about £25,000. One boat of the Smith's Dock Trust landed nearly twenty-six lasts of Herring, the largest catch by any boat during the season. The price realised was something like £12 per last. The Scotch boats did exceedingly well, and left several weeks before the end of the fishing, as they were evidently well satisfied with their harvest.

On Saturday, November 15th, 1902, I went over to Lowestoft for the purpose of gaining some information concerning the fishing, but found that I had set myself a difficult task. Everybody was so busy that they had no time to spare for answers to my questions. However, a little perseverance was rewarded and I was able to ascertain a few facts. The harbour was crowded, and had been in a congested state all the week. Boats lay for hours near the centre of the Dock basin unable to deliver their catches, and some were not able to move more than a few inches at a time. Nearly the whole area of the Fish Market was taken up by the Herring industry. There were Herrings everywhere in barrels, boxes, swills, heaped up on the floor of the market and on the quayside, until it was almost impossible to walk about.

One boat LT.738, brought in about thirteen lasts, and the steamer Dous 890 had about twenty lasts on board. As far as I could ascertain there were nearly 2000 Scotch girls and women working at Lowestoft.

It is interesting to learn that the Scotch fishermen still regard Yarmouth with great favour. I find that a larger number fished from this port during the past season, the total reaching 459 Scotch boats, and 29 from other ports. The Scotch boats comprised 139 from Banff, Kirkcaldy 78, Inverness 48, Fraserburgh 43, Leith 39, Berwick 35, Wick 22, Peterhead 20, Montrose 19, Aberdeen 13, Arbroath 2, Stornoway 1. In addition to these, North Shields sent 18, Hull 7, Grimsby 2, Sunderland 1, and Southampton 1.

From 'Eastern Daily Press':—"Scottish Boats Earnings.—Now that the Scottish fleet has arrived home, it is possible to obtain some information as to their earnings at our Herring fishing. From all the northern stations it is admitted that their 1902 season has been the best they have ever had. The Peterhead steam drifters have earned from £700 to £1100 each, the Banff steamer Promote is just £27 short of £1000. The Buckie steamers, Fame

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and Speedwell, had between £600 and £700 each. The sailing boats have done well, as a few examples will show. Among the earnings reported by Peterhead boats are the Mary Stephen £535, Unity £475, Pansy £450, Jeannies £430, Watchful, Speedwell, and Valiant £400 each, Maggie M. Birnie £350, Onward, Mary, and Victory £300 each, Brilliant £270, Nobles £230, Harmony, and British Ensign £200 each. The Fraserburgh boats that have done well are Philorth £640, Crawfords £560, Guide Me £550, Bill £510, and Speedwell £496. The Buckie boats have grossed between £300 and £400 per boat, and some of the Lossiemouth fleet have made over £600. The Scotch crews are now considering the best means of investing their well-earned money, and the popular idea is to go in for steam drifters. Already one first-class steam drifter has been ordered on Scotch account from Smith's Dock Trust, Limited, of Shields, and it is stated that it is in contemplation to place several similar contracts with this concern."

In conclusion I may add, that the total number of Herrings landed at Yarmouth and Lowestoft, as shown by the returns, amount to 78,774 lasts, giving the enormous total of 1,039,816,800 Herrings, which is nearly three times as many as were caught during the year 1897. In the latter year I find that altogether 530 boats sailed out of the two ports. This number has increased to 1216 in the year 1902.

I desire to acknowledge my indebtedness to Mr. W. L. Smith, the Borough Accountant of Great Yarmouth, and to Mr. H. J. Henderson, the harbour master of Lowestoft, for the returns of Herrings landed at those ports during 1902, also to Mr. H. D. Sayers for particulars concerning the various boats sailing out of Yarmouth for the fishing.

RETURN OF HERRINGS LANDED AT YARMOUTH IN 1902.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	740
February	—	July	525
March	2	August	1,230
April	64	September	2,603
May	79	October	18,442
June	595	November	19,552
		December	2,227
Carried forward	740	Total	45,319

Number of Yarmouth boats employed, about . 150
" Scotch and other boats employed, about 488

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RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1902.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	2,405
February	—	July	665
March	170	August	54
April	1,009	September	419
May	674	October	13,498
June	552	November	13,386
		December	3,028
Carried forward	2,405	Total	33,455

Number of Lowestoft boats . . . 235
„ Scotch „ . . . 338
„ West Country boats . . 5

XI.

NORFOLK DIPTERA.

BY REV. E. N. BLOOMFIELD, M.A., F.E.S.

Read 31st March, 1903.

As no list of Diptera has thus far been published by our Society, it may be thought well to print a preliminary list. I trust however that ere long some resident in the County will take up the subject and incorporate the present list with his own.

The main source of the following enumeration is Mr. Verrall's "Diptera of the Norfolk Broads," published in the 'Entomological Magazine,' vol. xviii. p. 149. Mr. C. Morley on his visit to the Broads in June, 1901, also took a good number of *Diptera*, most of these however being the same species as those met with by Mr. Verrall. Messrs R. C. Bradley and C. J. Wainwright of Birmingham spent a few weeks at West Runton in August, 1900, and have recorded some of the species met with by them in the

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'Entomologist's Monthly Magazine' and 'The Entomologist.' Mr. Tuck of Bury St. Edmunds has sent me a few specimens from Mousehold and Cromer, and Mr. Connold of St. Leonards brought a few from Aylsham; but the list is still extremely imperfect, and the various families are very unequally represented.

The sources from which this list is compiled and the abbreviations used are as follows.

R.C.B. R. C. Bradley, British Trypetidæ, Ent. Mo. Mag. vol. xxxvii. p. 9.
C.M. Claude Morley, F.E.S.
G.H.V. G. H. Verrall, F.E.S. "Diptera of the Norfolk Broads," Ent. Mo. Mag. vol. xviii. p. 149.
V. Verrall, 'British Flies,' vol. viii.
C.J.W. Colbran J. Wainwright, F.G.S., "Diptera in Norfolk," 'Entomologist' 1901, p. 201.
Tachinidæ, in 1901 Ent. Mo. Mag. vol. xxxvii. p. 212.

Where no authority is given in the general list the Diptera of the Norfolk Broads is to be understood, but in the Tachinidæ Mr. Wainwright's paper on that family.

Pulicidæ.

Pulex irritans, L. Common.
„ canis, Curt. Common.
Trichopsylla hirundinis, Curt. Thetford, in nests of the Sand Martins, C.M.

Cecidomyidæ.

Lasioptera rubi, Schrk. Aylsham, Connold.
Cecidomyia galii, Lw. Mundesley. Transactions, vol. iii. p. 110.

„ bursaria, Bremi.	Aylsham, Connold. Norfolk Galls. Transactions, vol. vii. p. 110.
„ crataegi, Winn.	
„ marginemtorquens, Bremi.	
„ rosaria, Lw.	
„ ulmariæ, Bremi.	
„ urticæ, Perris.	
Diplosis botularia, Winn.	
„ loti, Deg.	

Mycetophilidæ.

Platyura cincta, Winn. Ormesby, Verrall, Ent. Mo. Mag. vol. xxx. p. 79.

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Bibionidæ.

Scatopse halterata, Mag. The Broads.
,, transversalis, Lw. Near Thetford, Ent. Mo. Mag vol. xxii. p. 180.
,, notata, L. Common, Hist. Yar.
Bibio marci, L. Common, Hist. Yar.

Chironomidæ.

Ceratopogon unimaculata, Mcq.
,, bicolor, Mg.
,, solstitialis, Winn.
} Ormesby. Ent. Mo. Mag. vol. xxx. p. 140

Ptychopteridæ.

Ptychoptera contaminata, L. Common on the Broads, C.M.

Limnobidæ.

Limnobia bifasciata, Schrk. Oby, Hist. Yar.
,, trivittata, Schum. Brockdish near Scole, Verrall, Ent. Mo. Mag. vol. xxv. p. 125.
Rhipidia maculata, Mg. Rare, Hist. Yar.
Trichocera hiemalis, Deg. Norwich, C.M.

Tipulidæ.

Pachyrrhina crocata, L. Northend gardens, common, Hist. Yar.
,, guestfalica, Westh. Dickleburgh, in June, Ent. Mo. Mag. vol. xxv. p. 21.
Tipula gigantea, Schrk. Northend gardens, Hist. Yar.
,, oleracea, L. Common.
,, paludosa, Mg. Common in marshes, C.M.
,, fascipennis, Mg. Dickleburgh, in June, Ent. Mo. Mag. vol. xxv. p. 26.

Rhyphidæ.

Rhyphus fenestralis, Scop. Common, Hist. Yar.

Stratiomyidæ.

Oxycera pulchella, Mg. West Runton, C.J.W.

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Stratiomys chamæleon, L. West Runton on flower-heads of *Angelica*, C.J.W.

„ potamida, Mg. Oby, common in meadows, Hist. Yar.

Odontomyia? argentata, F. Wroxham, C.M.

„ viridula, F. Marshes, common, Hist. Yar.

Sargus flavipes, Mg. Mousehold, Tuck.

„ iridatus, Scop. Not common, Hist. Yar. Martham.

Chloromyia formosa, Scop. Common, Hist. Yar. Earlham, C.M.

Microchrysa polita, L. Common, Hist. Yar. Hickling, G.H.V. Mousehold, Tuck.

„ flavicornis, Mg. Hickling, G.H.V. and C.M. Surlingham, C.M.

Beris clavipes, L. Common, Hist. Yar.

„ vallata, Forst. Hickling, G.H.V. Horning, C.M. Cromer, Tuck.

Chorisops tibialis, Mg. West Runton, C.J.W.

Tabanidæ.

Hæmatopota pluvialis, L. Common.

Chrysops cæcutiens, L. Common, Hist. Yar.

„ relicta, Mg. Common, Hist. Yar. Horsey, C.M.

Leptidæ.

Leptis scolopacea, L. Common on tree trunks, C.M.

„ lineola, F. Aylsham, Connold.

Chrysopilus aureus, Mg. Cromer, Tuck.

„ auratus, F. The Broads, G.H.V. Aylsham and Surlingham.

Asilidæ.

Dioctria rufipes, Deg. Earlham and Rockland, C.M.

„ baumhaueri, Mg. Aylsham, Connold.

Dysmachus trigonus, Mg. Winterton, C.M. West Runton, C.J.W.

Bombylidæ.

Anthrax paniscus, Rossi. West Runton, C.J.W.

Therevidæ.

Thereva nobilitata, F. Gillingham, E. A Butler. Cromer, Tuck.

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THEREVA BIPUNCTATA, Mg. Cromer.
„ ANNULATA, F. Sandy coasts, G.H.V. Yarmouth, Verrall.

DOLICHOPODIDÆ.

DOLICHOPUS VITRIPENNIS, Mg. Hickling and Martham.
„ ATRATUS, Mg. Hickling and Ormesby.
„ LEPIDUS, Stæg. Hickling.
„ NUBILUS, Mg. The Broads.
„ PLUMIPES, Scop. Ormesby and Martham.
„ PENNATUS, Mg.
„ POPULARIS, W.
„ SIGNATUS, Mg.
„ NITIDUS, Fln.
„ GRISEIPENNIS, Stan. } Martham
„ SIMPLEX, Mg.
„ BREVIPENNIS, Mg.
„ ÆNEUS, Deg. } The Broads.
GYMNOPTERNUS CUPREUS, Fln.
„ CELER, Mg.
„ CHALYBÆUS, W. } Martham.
„ ÆROSUS, Fln. The Broads.
„ ASSIMILIS, Stæg. Martham and Hickling.
HERCOSTOMUS NANUS, Mcq. Ormesby.
CHRYSOTUS NEGLECTUS, W.
„ CUPREUS, Mcq.
„ GRAMINEUS, Fln. } Martham.
ARGYRA DIAPHANA, F.
„ ARGENTINA, Mg.
SYNTORMON MONILIS, Wlk. Hickling.
MEDETERUS PETROPHILUS, Kow. Cromer.
SCELLUS NOTATUS, F. Gardens, somewhat rare, Hist. Yar.
HYDROPHORUS BIPUNCTATUS, Lehm. The Broads in thousands.
„ LITOREUS, Fln. Martham and Ormesby.
„ PRÆCOX, Lehm. Ormesby.
„ VIRIDIS, Mg. Ormesby.
CAMPSICNEMUS SCAMBUS, Fln. Martham.
„ CURVIPES, Fln. The Broads.
THRYPTICUS BELLUS, Lw. Ormesby.
SYMPYCNUS ANNULIPES, Mg. The Broads.

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PIPUNCULIDÆ.

PIPUNCULUS CONFUSUS, Verr. Wroxham and Horning, C.M.
,, HÆMORRHOIDALIS, Zett. Wroxham, V.
,, LITTORALIS, Beck. Yarmouth sand dunes; Martham, V.

SYRPHIDÆ.

PIPIZELLA VIRENS, F. Ormesby.
,, FLAVITARSIS, Mg. Martham.
PIPIZA NOCTILUCA, L. Ormesby.
LIOGASTER SPLENDIDA, Mg. Martham.
,, METALLINA, F. Wroxham, C.M. Cromer, Tuck.
CHRYSOGASTER SPLENDENS, Mg. Ormesby.
,, HIRTELLA, Lw. Hickling, G.H.V. & Common, C.M.
,, CHALYBEATA, Mg. Martham and Hickling.
,, SOLSTITIALIS, Fln. Martham.
CHILOSIA PULCHRIPES, Lw. Hickling, G.H.V. Cromer, Tuck.
,, VARIABILIS, Pz. Hickling, Martham.
,, ALBITARSIS, Mg. Hickling, Martham.
,, FRATERNA, Mg. Ormesby, G.H.V.
PLATYCHIRUS MANICATUS, Mg. The Broads, G.H.V. Mousehold, Tuck.
,, PELTATUS, Mg. Hickling.
,, ALBIMANUS, F. The Broads.
,, FULVIVENTRIS, Mcq. Martham, G.H.V. Wroxham, C.M.
,, CLYPEATUS, Mg. Cromer, Tuck.
PYROPHÆNA GRANDITARSA, Forst. Ormesby and Martham, G.H.V. Gillingham, E. A. Butler. Common throughout the Broads in June, C.M.
,, ROSARUM, F. Martham, G.H.V. Wroxham, C.M.
MELANOSTOMA SCALARE, F. Horning, C.M.
LEUCOZONA LUCORUM, L. Earlham, C.M.
CATABOMBA PYRASTRI, L. Common.
SYRPHUS RIBESII, L. Common.
,, LATIFASCIATUS, Mcq. Martham.
,, COROLLÆ, F. The Broads.
,, BALTEATUS, Deg. Cromer, Tuck.
,, AURICOLLIS, Mg. Martham.

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SPHÆROPHORIA MENTHASTRI, L.
„ var. PICTA, Mg. The Broads.
ASCIA PODAGRICA, F. Doubtless common.
„ FLORALIS, Mg. Martham, &c.
RHINGIA CAMPESTRIS, Mg. Common, Hist. Yar. The Broads.
VOLUCELLA BOMBYLANS, L. Caistor, Hist. Yar. The Broads.
„ PELLUCENS, L. Mousehold, Tuck.
ERISTALIS SEPULCHRALIS, L. Ormesby.
„ TENAX, L. Common.
„ INTRICARIUS, L. Martham.
„ ARBUSTORUM, L. Common.
„ PERTINAX, Scop. Doubtless common.
„ HORTICOLA, Deg. Ormesby.
HELOPHILUS HYBRIDUS, Lw. Ormesby, Martham.
„ PENDULUS, L. The Broads.
„ FRUTETORUM, F. Ormesby, Martham.
„ VERSICOLOR, F. Ormesby, Martham, G.H.V. Rockland, C.M.
„ TRANSFUGUS, L. Breydon Marshes, Hist. Yar. Martham.
„ LINEATUS, F. Ormesby, Martham, G.H.V. Surlingham, C.M.
„ VITTATUS, Mg. Breydon Marshes, Hist. Yar.
TROPIDIA SCITA, Harr. Eaton, Norwich; very common through out the Broads in June, C.M.
XYLOTA SEGNIS, L. Martham.
SYRITTA PIPIENS, L. Aylsham, Connold.
EUMERUS STRIGATUS, Fln. Hunstanton, V.
SERICOMYIA BOREALIS, Fln. Caistor Marrams, Hist. Yar.
CHRYSOTOXUM OCTOMACULATUM, Curt. Dickleburgh, V.
„ FESTIVUM, L. Norfolk, V. West Runton, C.J.W.

CONOPIDÆ.

CONOPS FLAVIPES, L. Mousehold, Tuck.
PHYSOCEPHALA RUFIPES, F. West Runton, C.J.W.
ONCOMYIA ATRA, F. West Runton, C.J.W.
MYOPA FASCIATA, Mg. Mousehold and Cromer, Tuck.

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Tachinidæ.

Meigenia floralis, Mg.
Ceromasia machairopsis, Br. & Berg.
„ senilis, Mg. Common.
„ stabulans, Mg.
Exorista notabilis, Mg. Common.
Epicampocera succincta, Mg.
Blepharidea vulgaris, Fln. A common species.
Chætolyga quadripustulata, F. Common.
Tachina rustica, Mg.
Thelymorpha vertiginosa, Fln.
Melanota volvulus, F.
} West Runton.

Mintho præceps, Scop. Cromer, Tuck.
Macquartia tenebricosa, Mg. West Runton.
Anthracomyia nana, Mg. West Runton, C.J.W. Wroxham, C.M.
Thelaira leucozona, Pz. The Broads, G.H.V. West Runton, common.
Olivieria lateralis, F. Common.
Micropalpus vulpinus, Fln.
Erigone radicum, F. A common species.
Rœselia antiqua, Fln.
Phyto parvicornis, Mg. (P. melanocephala var.?)
Frauenfeldia trilineata, Mg. New to Britain.
Brachycoma devia, Fln.
} West Runton.

Clista lepida, Mg.
Sarcophaga carnaria, L. Common.
Heteronychia chætoneura, Br. & Berg. One specimen.
Miltogramma punctatum, Mg. Several with Aculeates and on Ragwort bloom.
Metopia leucocephala, Rossi.
Macronychia agrestis, Fln.
Dexiosoma caninum, F. Abundant on Bracken.
Prosena sybarita, F. Common on Ragwort, but also on other flowers.
Dinera grisescens, Fln.
} West Runton.

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Muscidæ.

Stomoxys calcitrans, L. Common.
Graphomyia maculata, Scop. The Broads, G.H.V. Mousehold, Tuck.
„ picta, Zett. Martham.
Musca domestica, L. Common.
„ corvina, F. Common.
Morellia hortorum, Fln. Mousehold, Tuck.
„ curvipes, Mcq. Hickling.
Mesembrina meridiana, L. Common, Hist. Yar.
Pyrellia cadaverina, L. Mousehold, Tuck.
Calliphora erythrocephala, Mg. Common.
Lucilia cæsar, L. Common.

Anthomyidæ.

Polietes lardaria, F. St. Benets Abbey, C.M.
„ albolineata, Fln. Hickling.
Hyetodesia incana, W. Hickling and Ormesby.
„ lucorum, Fln. The Broads.
„ variabilis, Fln. Horning, C.M.
„ errans, Mg. Surlingham and Rockland, C.M.
„ signata, Mg. Hickling, Verrall.
„ basalis, Zett. The Broads.
„ rufipalpis, Mcq. Ormesby.
Mydea urbana, Mg. Surlingham, C.M. The Broads.
„ allotalla, Mg. Martham.
„ pagana, F. Aylsham, Connold,
Spilogaster protuberans, Ztt. Yarmouth, Ent. Mo. Mag. vol. xxx. p. 143.
Sphecolyma inanis, Fln. Martham.
Melanochila riparia, Fln. Hickling, C.M.
Hydrophoria conica, W. The Broads.
„ socia, Fln. Royden Fen, Diss, C.M.
Hylemyia strigosa, F. Wroxham, abundant, C.M.
„ puella, Mg. Horning, C.M.
Anthomyia pluvialis, L. The Broads, G.H.V. Aylsham, Connold.

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PHORBIA DISCRETA, Mg. South Walsham. Ent. Mo. Mag. vol. xxii. p. 232.

HOMALOMYIA CANICULARIS, L. Doubtless common.

HOPLOGASTER MOLLICULA, Fln. Surlingham and Horning, C.M.

CŒNOSIA ELEGANTULA, Rnd. (*H. tricolor*). Wroxham, C.M.

CORDYLURIDÆ.

PARALLELOMMA ALBIPES, Fln. Rockland, C.M.

CNEMOPOGON APICALIS, Mg. S. Walsham, Verrall.
TRICHOPALPUS PUNCTIPES, Mg. Martham, Verrall.
GYMNOMERA TARSEA, Fln. Hickling.
} Ent. Mo. Mag. vol. xxx. p. 144.

SCATOPHAGA STERCORARIA, L. Common.

SCIOMYZIDÆ.

ACTORA ÆSTUUM, Mg. Common on the beach in August, Yarmouth. Hist. Yar., and G.H.V.

SCIOMYZA ALBOCOSTATA, Fln. Horning, C.M.

TETANOCERA FERRUGINEA, Fln. Hickling.

„ CORYLETI, Scop. The Broads.

LIMNIA MARGINATA, F. Marrams, Hist. Yar.

„ UNGUICORNIS, Scop. West Runton, C.J.W.

„ RUFIFRONS, F. West Runton, C.J.W.

SEPEDON SPHEGEUS, F. Marshes, common, Hist. Yar.

„ SPINIPES, Scop. Hickling, G.H.V. Horning, C.M.

PSILIDÆ.

PSILA FIMETARIA, L. Rather rare, Hist. Yar. Aylsham, Connold.

MICROPEZIDÆ.

MICROPEZA CORRIGIOLATA, L. Cromer, Tuck.

CALOBATA PETRONELLA, L. Horning, common, C.M.

ORTALIDÆ.

PTEROPÆCTRIA FRONDESCENTIÆ, L. Hickling, C.M. West Runton, C.J.W.

CEROXYS CRASSIPENNIS, F. Ranworth, C.M.

PLATYSTOMA SEMINATIONIS, F. Wortham, abundant on flowers, C.M.

RIVELLIA SYNGENESIÆ, F. West Runton, C.J.W.

SEOPTERA VIBRANS, L. Aylsham, Connold.

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TRYPETIDÆ.

SPILOGRAPHA ALTERNATA, Fln. West Runton, 1 ♂ R.C.B.
TRYPETA CORNUTA, F. West Runton, common on *Centaurea scabiosa*, R.C.B. & C.J.W.
„ TUSSILAGINIS, F. West Runton, common on Burdock, R.C.B. & C.J.W.
„ CYLINDRICA. Martham.
UROPHORA SOLSTITIALIS, L. West Runton, common on *Centaurea nigra*, R.C.B. & C.J.W.
SPHENELLA MARGINATA, Fln. West Runton, common on Ragwort, R.C.B.
ENSINA SONCHI, L. West Runton, R.C.B.
TEPHRITIS MILIARIA, Schrk. The Broads.
„ TESSELLATA, Lw. West Runton, seven specimens, R.C.B. & C.J.W.
„ VESPERTINA, Lw. West Runton common, R.C.B.
„ BARDANÆ, Schrk. Aylsham, Connold. West Runton, abundant on Burdock, R.C.B.
URELLIA ELUTA, Mg. West Runton, 1 ♀ R.C.B.
„ STELLATA, Fuessl. West Runton, R.C.B.

LOUCHÆIDÆ.

PALLOPTERA USTULATA, Fln. Dickleburgh, Verrall. Mousehold and Cromer, Tuck.

SAPROMYZIDÆ.

SAPROMYZA FASCIATA, Fln. Cromer, Tuck.
LAUXANIA HYALINATA, Mg. Cromer, Tuck.

OPOMYZIDÆ.

BALIOPTERA TRIPUNCTATA, Fln. Yarmouth, G.H.V. Cromer, Tuck.
OPOMYZA GERMINATIONIS, L. Cromer, Tuck.

EPHYDRIDÆ.

NOTIPHILA ULIGINOSA, Hal. Horning, abundant in flowers of *Nymphæa lutea*, C.M.

HIPPOBOSCIDÆ.

OXYPTERUM PALLIDUM, Leach. On Swifts, rare, Hist Yar.

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XII.

HEPATICÆ OF NORFOLK.

By Rev. E. N. Bloomfield, M.A., F.E.S.

Read 31st March, 1903.

The county of Norfolk, like the rest of the Eastern counties, has no hills worthy of the name; the air is dry and the rainfall less than that of the western part of England. We cannot therefore expect that any large number of the Hepaticæ should be found in the county, since they generally require a moist climate. In Norfolk, however, the British Hepaticæ seem to have been most diligently studied early in last century, especially by the Rev. R. B. Francis, and to him is due the first discovery in Britain of several very interesting species: these were mostly found by him at Holt and Edgefield, and we are indebted to Sir W. J. Hooker for the record of Mr. Francis' more notable discoveries. There were at that time, however, several good botanists from whom we have records of Norfolk Hepaticæ; of these I might mention Sir W. J. Hooker himself, Mr. Dawson Turner of Yarmouth, and Messrs Woodward and Stone of Bungay; but since the early part of the last century very little attention has been given to this class of plants, as far as Norfolk is concerned.

Within the last two or three years, however, a few fresh observations have been made by Mr. E. M. Holmes of Sevenoaks, Kent, and by Mr. W. H. Burrell of Sheringham. The majority of their specimens were collected in the same localities which Mr. Francis investigated so successfully, and it is very interesting to find that most of the species observed by him about a hundred years ago are still found in the same stations.

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I am indebted to Mr. W. H. Pearson, the author of British Hepaticæ, for full extracts from Hooker's Jungermanniæ, and also for a record of the species found by Mr. E. M. Holmes when visiting Norfolk in 1900, while Mr. M. B. Slater of Malton, Yorkshire, has very kindly determined or confirmed Mr. Burrell's specimens. Most of the early records are from Hooker's Jungermanniæ, but some are from the 'Old Botanists' Guide,' 'Withering's Arrangement,' and 'Paget's Natural History of Yarmouth.' The Herbarium of the late Mr. E. Skepper of Bury St. Edmunds also contains a few Norfolk specimens, and there is a list of Hepaticæ by Miss A. M. Barnard in 'Mason's History of Norfolk.' The nomenclature is for the most part that of the London Catalogue of British Mosses and Hepatics, 1881.

The Abbreviations are as follows:—

W. H. B. Mr. W. H. Burrell, Sheringham.
E. M. H. Mr. E. M. Holmes, F.L.S., Sevenoaks.
O. B. G. 'Old Botanists' Guide,' 1805.
With: 'Withering's Arrangement,' Edition VI.
Hist. Yar. Sketch of the Natural History of Yarmouth, by C. J. and James Paget, 1834.

The numbers are those of the vice-counties, 27. East Norfolk. 28. West Norfolk.

MARCHANTIÆ.

MARCHANTIA POLYMORPHA, L. 27. Holt, W. H. B. Doubtless, common.

CONOCEPHALUS CONICUS, L. 27. Very common, but only found in fruit at one place on the shady bank of a ditch at Ditchingham, Mr. Woodward (With.). Bank of stream near Blickling Mills, W. H. B.

ASTERELLA (REBOULIA) HEMISPHERICA, L. 27. At Thorpe Market by the road from North Walsham to Cromer, Rev. G. R. Leathes. On an old bank at Antingham near the ponds, D. T. (O. B. G.) Guestwick, Skepper's Herbarium. Roughton, on hedge bank by roadside in considerable quantity, several square feet in area: Beeston Regis, growing on a small hillock raised a few inches above the swampy ground, W. H. B.

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RICCIEÆ.

RICCIA GLAUCA, L. 27. Common, Hist. Yar. In clover stubbles near Bungay, frequent, Mr. Stone. Usually growing with *Targionia sphærocarpus*, and at the same time, Mr. Woodward (With.).

RICCIELLA FLUITANS, L. 27. Ditches at Heigham, Hist. Yar.

RICCIOCARPUS NATANS, L. 27. Near Heydon, Mr. Bryant (O. B. G).

JUNGERMANNIACEÆ.

FRULLANIA DILATATA, L. 27. Trees at Caistor &c., Hist. Yar. Sheringham, W. H. B. Usually very abundant.

RADULA COMPLANATA, L. 27. Trunks of trees, Caistor &c. Hist. Yar. And in Miss Barnard's List.

PORELLA PLATYPHYLLA, L. Miss Barnard's List.

LEPIDOZIA SETACEA, Mitten. 27. Holt Bogs among *Sphagna*, Rev. R. B. Francis, E. M. H. and W. H. B. 28. Wolverton, E. M. H.

„ REPTANS, L. 27. Blickling, near Aylsham, on the ground under trees, W. H. B. And in Miss Barnard's List.

CEPHALOZIA (ODONTOSCHISMA) SPHAGNI, Dicks. 27. Holt Bogs, Rev. R. B. Francis, and W. H. B.

„ FRANCISCI, Hook. 27. About Holt and Edgefield. "I gladly take the opportunity of distinguishing the present species by the name of its discoverer, my friend the Rev. R. Francis, who has so successfully investigated the vicinity of his residence in search of the plants of this genus and has so kindly and liberally communicated to me numerous specimens, and much valuable information respecting them." W. J. Hooker. Holt bogs, scarce, W. H. B.

„ FLUITANS, Nees. 27. Holt Bogs, E. M. H. and W. H. B. 28. Wolverton, E. M. H.

„ DIVARICATA, Sm. (*Jung. byssacea*). 27. Holt and Edgefield Heaths, Rev. R. B. Francis, (O. B. G.) First discovered in this country by the Rev. R. B. Francis, on heathy and exposed situations in the

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neighbourhood of Holt. Far from uncommon in similar places in various parts of Norfolk, W. J. Hooker. Mr. Dawson Turner found it growing in great profusion, but always barren on the sand-hills at Hemsby.

CEPHALOZIA BICUSPIDATA, L. 27. Damp banks, &c., common, Hist. Yar. Sheringham, W. H. B., 28. Outside Sandringham Park, E. M. H.

„ LAMMERSIANA, Hübn. 27. Holt Bogs, W. H. B.

„ CONNIVENS, Dicks. 27. In boggy places in the neighbourhood of Holt and Edgefield, Rev. R. B. Francis. Holt Bogs, E. M. H. and W. H. B.

„ CATENULATA, Hübn. 28. Wolverton, E. M. H.

LOPHOCOLEA BIDENTATA, L. 27. Among Hypnum, Hist. Yar. Sheringham, W. H. B.

„ var. OBTUSATA, Hook. Found by the Rev. R. B. Francis in very wet and boggy parts of Holt Heath.

„ HETEROPHYLLA, Schrad. 27. "First detected in this country by the Rev. R. B. Francis growing on decaying trunks of trees in Edgefield Wood, also at the foot of Alders in Hanworth Meadows, Norfolk," W. J. Hooker.

KANTIA TRICHOMANIS, L. 27. Near Holt, E. M. H. Holt, &c., W. H. B.

BLEPHAROZIA CILIARIS, Nees. 27. On a dry sandy bank on Brome Heath near Bungay, Mr. Stone (With.).

SCAPANIA COMPACTA, Roth. (J. RESUPINATA, Hook). 27. About Edgefield on a loamy soil and on the heath at Hempstead Hill, Rev. R. B. Francis. Not unfrequent in various parts of Norfolk in shady places under the trailing stems of *Ericæ*, W. J. Hooker.

„ NEMOROSA, L. 27. Woods near Holt, Rev. R. B. Francis, (O. B. G). Woods near Norwich, W. J. Hooker. var. *asper*. 27. Holt Bogs, W. H. B.

„ CURTA, Mart. (J. NEMOROSA var. DENUDATA, Hook.) 27. Edgefield, Rev. R. B. Francis.

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DIPLOPHYLLUM ALBICANS, L. 27. Muckle Moor near Holt, Skepper's Herbarium. Sheringham, in woods, W. H. B.

PLAGIOCHILA ASPLENIOIDES, L. 27. Earsham and Sexton Woods near Bungay, Mr. Stone (With.). Miss Barnard's List.

MYLIA TAYLORI. Hook. 28. Wolverton, E. M. H.

„ ANOMALA, Hook. 27. Holt Lows; Bogs on the south side of Edgefield Hill on the road to Holt and in Holt Wood, growing both upon peat, earth and among *Sphagna*, Rev. R. B. Francis. Holt Heath, E. M. H. Holt Bogs, W. H. B. First detected by the Rev. R. B. Francis in Holt Moss.

JUNGERMANNIA CRENULATA, Sm. 27. On the boggy parts of Holt Heath, Rev. R. B. Francis.

„ var. GRACILLIMA, Sm. 27. Loamy soil in Edgefield Wood, and by the road sides in the vicinity, Rev. R. B. Francis.

„ GRACILIS, Schl. (J. BARBATA var. MINOR Hook). 27. Discovered by the Rev. R. B. Francis, growing among *Dicranum glaucum* in Holt Wood.

„ EXSECTA, Schmid. "Moist and especially boggy heaths in various parts of Norfolk as—27. Holt and Edgefield Heaths, (where it was for the first time discovered in England by the Rev. R. B. Francis,) and Mousehold Heath, Norfolk."

„ VENTRICOSA, Dicks. 27. "The Rev. R. B. Francis has for many years noticed it in the neighbourhood of his residence attached both to a boggy and loamy soil, in Holt Wood and Lows, as well as Edgefield Wood, and on the heath, growing also among *Sphagnum*." W. J. Hooker.

„ PORPHYROLEUCA, Nees. 27. Holt Bogs, W. H. B.

„ CAPITATA, Hook. (J. EXCISA Dicks, p. p.) 27. Edgefield in wet places plentiful, Rev. R. B. Francis. Abundant upon Mousehold Heath near Norwich, and on hedge banks and heathy places near Yarmouth, W. J. Hooker.

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JUNGERMANNIA BICRENATA, Lind. 27. Ballast heap in brick pit Holt, W. H. B.

„ INCISA, Schrad. 27. Holt Lows and Edgefield Heath, Rev. R. B. Francis.

„ INFLATA, Huds. 27. Holt Bog with *C. Francisci* sparingly, W. H. B. 28. Outside Sandringham Park, E. M. H.

NARDIA SCALARIS, Schrad. 27. Shady side of bank on heathland, Sheringham, W. H. B. Miss Barnard's List.

PELLIA EPIPHYLLA, L. 27. Near Yarmouth, Hist Yar. Sheringham, W. H. B. Doubtless common.

ANEURA PINGUIS, L. 27. Near Yarmouth, Hist. Yar. Holt Bogs, E. M. H. and W. H. B.

„ MULTIFIDA, Dill. 27. Among *Sphagna*, Hist. Yar. Holt Bogs, W. H. B.

METZGERIA FURCATA, L. 27. Sheringham and Beeston Regis, W. H. B.

SPHÆROCARPUS TERRESTRIS, S. M. 27. Clover field at Heydon, Rev. H. Bryant. Near Norwich, Mr. Crowe. Abundant at Caistor and other places round Yarmouth, D. T. (O. B. G). Very common in our clover-fields in autumn on sandy loam, along with *Riccia glauca*, the first year of the clover, Mr. Woodward (With.). Turnip and clover-fields and hedge banks, Caistor, Hist. Yar.

ANTHOCEROS PUNCTATUS, L. 27. Brome on the borders between the high and boggy ground Mr. Woodward, (O. B. G). Ellingham Fen, Mr. Stone (With.).

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XIII.

SUPPLEMENTARY LIST OF NORFOLK MOSSES.

By H. N. Dixon, M.A., F.L.S.,

Hon. Mem. Caradoc and Severn Valley Field Club.

Read 31st March, 1903.

Since the publication of 'A Preliminary List of Norfolk Mosses, in these Transactions (vol. vii. p. 212) in 1901, a number of additional records have been made. The principal contributions have been made by the Rev. W. E. Thompson, M.A., who, collecting in the shoreward parishes of Thornham, Titchwell, Holme, and the neighbourhood, has added a considerable number to the recorded species from the western division of the county, vice-county 28. His list includes also several new county records, to which must be added some further records by Mr. W. H. Burrell and Sir Jas. Stirling. The names of these collectors are abbreviated in the succeeding list as follows, W. E. T., W. H. B., J. S.

The total number of species here added to the county list is twenty-one (in addition to the confirmation of two or three as to which the previous records admitted of some slight doubt), thus bringing the total number hitherto recorded to about 190. An asterisk is prefixed to county records; vice-county records are indicated by the number of the V.C. In a few instances additional localities for rarer species already recorded have been given, not constituting a V.C. record, in these cases the V.C. number is enclosed in brackets.

The most interesting observation is the addition to the British Flora of *Bryum mamillatum*, hitherto only known as an inhabitant of the Baltic region; of this a fuller notice will be found in the list.

I may add that nearly all the species enumerated below, all the critical ones at least, have passed through my hands.

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DICRANACEÆ.

* SELIGERIA CALCAREA, B. and S. 28. Thornham chalk quarry and quarries at Holme and Ringstead (W. E. T.). Fruit abundant in winter and spring, ripe in spring. A form with short seta, almost overtopped by the perichætial bracts, probably the form which is described as the type by Limpricht, but which is certainly not ours.

DICRANELLA VARIA, Schp. 28. Occasionally on inland banks of Thornham Marsh (W. E. T.).

,, CERVICULATA, Schp. 28. Roydon Common (J. S.).

* ,, RUFESCENS, Schp. 27. Beeston Regis (W. H. B.).

* ,, SCHREBERI, Schp. 27. Brick earth pit, Beeston Regis (W. H. B.).

DICRANUM SCOPARIUM, Hedw. 28. Snettisham, Sandringham (J. S.). Hunstanton and Holme Dunes, and Ringstead Heath (W. E. T.).

* ,, BONJEANI, De Not. 28. Snettisham Common (J. S.).

* CAMPYLOPUS FLEXUOSUS Brid. 28. Snettisham Common (J. S.).

,, BREVIPILUS, B. and S. 27. Roughton Heath (W. H. B.).

FISSIDENTACEÆ.

FISSIDENS BRYOIDES, Hedw. 28. Abundant on all moist banks inland (W. E. T.).

* ,, ADIANTOIDES var. COLLINUS, Braithw. 28. Plentiful on roadside bank, Thornham Heath, high ground, inland (W. E. T.). The cells are distinctly smaller than in the type, though not obscure as in *F. decipiens*; in this as in the habit the plant agrees well with Mitten's description of *F. collinus*, as well as with the Southdowns plants of *F. adiantoides*, to which the name is no doubt intended to apply (although some authenticated specimens have proved to belong to *F. decipiens*).

,, TAXIFOLIUS, Hedw. 28. Abundant on all moist banks inland (W. E. T.).

GRIMMIACEÆ.

* RHACOMITRIUM CANESCENS var. ERICOIDES, B. and S. 28. North Wootton Common (J. S.).

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TORTULACEÆ.

PHASCUM CUSPIDATUM, Schreb. 28. Locally abundant, Thornham Marsh, etc. (W. E. T.)

" " var. PILIFERUM, H. and T. 28. Sea-bank of Titchwell Marsh, March, 1903 (W. E. T.).

POTTIA BRYOIDES, Mitt. (27). Fallow land, Sheringham (W. H. B.).

" HEIMII, Fürnr. 28. "Literally swarms over the whole of Holme Marsh, and occurs occasionally on Thornham and Titchwell Marshes" (W. E. T.). (27). Weybourne (W. H. B.).

" TRUNCATULA, Lindb. 28. Sandringham (J. S.). Thornham (W. E. T.).

" INTERMEDIA, Fürnr. 28. Sandringham (J. S.). Thornham (W. E. T.).

" MINUTULA, Fürnr. 28. Thornham Vicarage grounds and quarry (W. E. T.).

" LANCEOLATA, C. M. 28. Titchwell and Thornham (W. E. T.). 27. Sheringham (W. H .B.).

TORTULA PUSILLA, Mitt. 28. Mud-capped walls, Titchwell and Ringstead (W. E. T.).

* " LAMELLATA, Lindb. 28. Same walls as the last, plentiful (W. E. T.).

" AMBIGUA, Angstr. 28. Same walls as the above, poor but plentiful (W. E. T.). Mr. Thompson adds that these three last mentioned Mosses must have been once very abundant in this district, and are still plentiful at Titchwell where many mud-capped walls may still be found; but the mud-capping is rapidly being replaced by cement or brick coping, and these Mosses will probably disappear at an early date.

* " LÆVIPILA, Schwaeg. 28. On Elder and Thorn in hedges, Thornham, and Holme (W. E. T.).

" RURALIS, Ehrh. 28. "Occasional" (W. E. T.).

" RURALIFORMIS, Dixon. (28). "Abundant in fruit. Swarms over Holme Dunes, and extends along the coast on either side" (W. E. T.).

* BARBULA RUBELLA, Mitt. 28. Titchwell, Thornham (W. E. T.). The previous record may possibly have been for Suffolk.

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BARBULA TOPHACEA, Mitt. 28. Thornham Marsh (W. E. T.).

„ FALLAX, Hedw. 28. Thornham, etc. (W. E. T.)

* „ CONVOLUTA, Hedw. 28. Sandringham; N. Wootton Common (J. S.).

* WEISIA MICROSTOMA, C. M. 28. Inland bank of Thornham Marsh (W. E. T.).

„ VIRIDULA, Hedw. 28. "Abundant on banks" (W. E. T.).

ORTHOTRICHACEÆ.

* ORTHOTRICHUM ANOMALUM var. SAXATILE, Milde. 28. Holme church wall (W. E. T.).

„ AFFINE, Schrad. 28. Thornham (W. E. T.).

FUNARIACEÆ.

PHYSCOMITHIUM PYRIFORME, Brid. 28. Sides of wet ditches, Titchwell, etc. (W. E. T.).

FUNARIA FASCICULARIS, Schp. 28. One fine patch at Thornham Vicarage (W. E. T.). 27. Holt; Sheringham; West Beckham (W. H. B.).

„ HYGROMETRICA, Sibth. 28. Titchwell (W. E. T.).

MEESIACEÆ.

* AULACOMNIUM ANDROGYNUM, Schwaeg. 27. Norwich; Hempstead near Holt; Weybourne (W. H. B.).

BARTRAMIACEÆ.

* PHILONOTIS CALCAREA, B. and S. 27. Holt bog (W H. B.).

BRYACEÆ.

* WEBERA ANNOTINA, Schwaeg. 28. Beeston Regis (W. H. B.). A rather perplexing form. Some of the specimens showed the numerous short bulbils characteristic of *W. annotina* (segregate), as defined by Correns, while others were equally clearly *W. proligera*, Kindb. Some of the latter form, however, showed a tendency to produce the shorter, not fusiform bulbils in the lower leaf axils, indicating a connection between the two forms. I also detected a single stem of the var. *erecta* (Correns).

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WEBERA CARNEA, Schp. 28. Roydon Common (J. S.). Thornham (W. E. T.).

* BRYUM MAMILLATUM, Lindb. 28. Among *Juncus gerardi* on low ground between sand dunes. Hunstanton Links, May, 1902. Rev. W. E. Thompson.

As this is the first record of this very rare species in Britain it deserves a somewhat extended notice. Mr. Thompson sent me the plant in June, for determination. I could not make it agree with any of our British species, and on comparing it with the descriptions of continental species I could find none with which it agreed but *Bryum mamillatum*, Lindb., a species only recorded hitherto from the sandy shores of the islands of Gothland and Aland in the Baltic. On comparing it with my specimens gathered there by Bomansson I could detect only slight and as it seemed to me comparatively unimportant differences. In order to clear up any doubt I sent specimens to Dr. Hagen, the acknowledged authority on, at any rate, the northern species of this very critical group. Dr. Hagen was at first inclined to think the differences of somewhat greater importance, but upon a further study of fresh material of *B. mamillatum* from its Scandinavian stations he recognised that its variations were sufficiently extended to include our plant, so that its identification with *B. mamillatum* may be looked upon as unquestioned. I am describing and figuring it in a second edition of the 'Student's Handbook of British Mosses' now in preparation, and it is scarcely needful to give a full diagnosis here; but some notes as to its distinguishing characters may be worth giving. Systematically it holds a position of somewhat peculiar interest, as it affords a link in some degree between the sections Ptychostomum and Cladodium in the genus Bryum. In each of these sections the peristome is imperfect, the cilia of the inner peristome being more or less undeveloped, sometimes quite rudimentary or wanting, or if longer, always without the transverse appendages or bars which characterise the fully developed peristome of Eu-bryum and of most Hypnaceæ; while the inner peristome is usually more or less united with the outer. The two sections differ from one another in the structure of the inner surface of the teeth of the outer peristome. This surface in Cladodium consists of rectangular plates set one above another, and separated by transverse divisions or bars which are strongly thickened, projecting

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inwards like the rungs of a ladder. The tooth therefore when viewed by transmitted light and a low power presents the simple structure of a yellow strip with regular transverse bars. In Ptychostomum it is different. The internal transverse bars are connected with one another by a series of irregular partitions, some vertical, some oblique, giving the appearance of an irregular network of lines when the tooth is examined as above. This is especially marked in *B. pendulum*, and often nearly as distinct in *B. warneum*. In some species however, such as *B. arcticum*, the irregular connecting lines are much fewer, and may be reduced to a single almost vertical connection between each pair of transverse bars, down the median line of the tooth. Now in *B. mamillatum* the teeth are almost entirely free from these connecting partitions, so that it appears to belong to the section Cladodium; but on careful examination a single oblique partition or two may be seen here and there between the lowest transverse bars at the very base of the tooth. It therefore, as has been said, forms in some degree a connecting link between the two sections.

This structure of the peristome distinguishes *B. mamillatum* clearly from *B. warneum*, which in other respects it resembles more closely than any other of our species. In addition to this the leaf margin is more strongly recurved than is *B. warneum*, the mouth of the capsule wider, the lid flatter, and the cells of the outer layer of the capsule wall much less incrassate; *B. lacustre* differs in the much smaller spores, the smaller more pointed lid, the less strongly bordered leaves, and the inflorescence synoicous, not autoicous. *B. pendulum* differs at once in the peristome, while both it and *B. inclinatum* have more tapering leaves with more excurrent nerve, and leaves red at the base. The other allied British species of these two sections (except the high alpine species, *B. arcticum*, *B. purpurascens* and *B. lawersianum*) are known at once by the obtuse or sub-obtuse leaves with nerve ceasing below the apex.

The spores in *B. mamillatum* are larger than in any other species of Bryum with which I am acquainted. In Bomansson's specimens from Aland they measure 40—50μ. In the Norfolk plant they average 48μ, many reach 55μ, and a few as much as 62 and 67μ. Altogether it is a very interesting plant, and a great acquisition to our moss flora.

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BRYUM PENDULUM, Schp. (28). Fine specimens in good fruit, on bank of ditch on Titchwell Sand Dunes (W. E. T.).

„ PSEUDOTRIQUETRUM, Schwaeg. 28. Bog on Titchwell Marsh (W. E. T.).

* „ CAPILLARE var. ELEGANS, Braithw. In velvety cushions on Titchwell Dunes, rare (W. E. T.).

* „ OBCONICUM, Hornsch. 28. Ringstead Heath (W. E. T.).

* „ CÆSPITICIUM L. var. With the *Bryum mamillatum* described above Mr. Thompson sent another Bryum from Holme Sand Dunes, which on examination proved to be a *Bryum cæspiticium*, but to differ in some points, which while not very conspicuous were of no unimportant value. The spores were considerably larger than in the type, (where they average 10—14μ), viz. 16—22μ, averaging about 18—20μ, a few being oval and considerably longer. The inner peristome was of a deeper orange than is usual; and the outer teeth frequently showed a few oblique partitions here and there between the lamellæ on the ventral surface, as in the section Ptychostomum. This curious plant has been submitted to Dr. Hagen, who considers it a marked form of varietal rank at least.

* „ ERYTHROCARPUM, Schwaeg. 28. Hedgebank, Thornham (W. E. T.).

„ ATROPURPUREUM, W. and M. 28. Thornham (W. E. T.).

„ ROSEUM, Schreb. (27). Holt (W. H. B.).

MNIUM ROSTRATUM, Schrad. 27. Edgefield Heath, bog (W. H. B.).

„ UNDULATUM, L. 28. Thornham (W. E. T.).

* „ PUNCTATUM, L. 27. Bog, Edgefield Heath (W. H. B.).

NECKERACEÆ.

* NECKERA PUMILA, Hedw. 27. On tree, Sheringham (W. H. B.).

„ COMPLANATA, Hübn. 28. Snettisham (J. S.).

HYPNACEÆ.

CAMPTOTHECIUM LUTESCENS, B. and S. (28). Fruiting, Ringstead (W. E. T.).

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BRACHYTHECIUM ALBICANS, B. and S. (28). Fruit abundant on the sea coast (W. E. T.).

„ VELUTINUM, B. and S. 28. "Frequent" (W. E. T).

„ PURUM, Dixon. (28). "Common. One patch with fine fruit, Thornham" (W. E. T.).

EURHYNCHIUM PUMILUM, Schp. 28. Near Thornham windmill, on moist banks (W. E. T.).

* „ MYOSUROIDES, Schp. 28. A small quantity, barren, growing with *E. confertum;* tree stump behind Ringstead Church (W. E. T.).

„ STRIATUM, B. and S. 28. Thornham (W. E. T.).

* „ MEGAPOLITANUM, Milde. 28. With abundant fruit, Thornham Heath on hedge-bank (W. E. T.).

* PLAGIOTHECIUM BORRERIANUM, Spr. 28. Beeston Regis (W. H. B.).

AMBLYSTEGIUM SERPENS, B. and S. 28. "Abundant" (W. E. T.).

„ FILICINUM, De Not. 28. In fine fruit, Titchwell Marsh (W. E. T.).

HYPNUM STELLATUM, Schreb. 28. A small form, in bog on Titchwell Marsh (W. E. T.).

„ ADUNCUM, Hedw. 28. Boggy pool, Ringstead, Thornham Marsh (W. E. T.). Plants of the "*pseudo-fluitans* group" also were sent by Mr. Thompson from Ringstead.

* HYPNUM WILSONI, Schp. "Norfolk, coll. Rev. W. W. Mason, *teste* Renauld." Mr. J. A. Wheldon informs me that he has a specimen of the above plant in his herbarium.

„ CUPRESSIFORME var. TECTORUM, Brid. 28. "Abundant" (W. E. T.).

„ MOLLUSCUM, Hedw. 28. Thornham and Ringstead (W. E. T.)

„ CUSPIDATUM, L. 28. Sandringham (J. S.). Titchwell, etc. (W. E. T.).

„ CORDIFOLIUM, Hedw. 28. Damp places, North Wootton Common (E. M. Holmes).

HYLOCOMIUM SPLENDENS, B. and S. 28. Ringstead (W. E. T.).

„ SQUARROSUM, B. and S. 28. In fine fruit, Thornham (W. E. T.).

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XIV.

NATURAL HISTORY NOTES FROM YARMOUTH.

By A. Patterson.

Read 31st March, 1903.

1902—1903.

March 13th. A ten-inch Ballan Wrasse (*Labrus maculatus*) was found amongst a parcel of Whitings.

On March 17th, a twelve-inch example of the Lumpsucker (*Cyclopterus lumpus*) was taken with shrimps in a net off-shore. Six hours after it had left the water it was still alive; so much so that when brought to me and laid upon a dish, it adhered so tenaciously that the dish did not fall off when the fish was lifted.

On March 27th, Müller's Topknot. A very beautiful, fresh example of (*Zeugopterus punctatus*) was landed. Length 7½ inches. It has been preserved for the Yarmouth Museum.

As late as April I saw Dunlins and other small Waders wearing the grey dress of winter.

On April 5th, after a gale from the N.E., during a long ramble on the beach, north of Yarmouth, I observed hundreds of five-rayed Starfishes (*Uraster rubens*) and eleven, twelve and thirteen-rayed Stars (*Solaster papposa*), with hundreds of empty shells of the Horse Mussel (*Modolia modiolus*). And with them many "Sea-mice." I was surprised at not finding a single Rockbird; these had probably already gone safely north.

An interesting accident *anent* the Starfishes happened to Mr. B. Dye's Cat. I had left him a few Sunstars; and during the tea-hour the feline member of the family managed to devour the half of one. In half an hour's time she could not walk straight, and groaned piteously. After a collapse of some hours' duration she got upon her feet, and could just manage to stagger along; her jaws which had become rigid, relaxed. The symptoms were altogether those of poisoning, next day however, she was herself again; and I received emphatic orders never to bring Starfishes there again.

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April 9th. An unusually large Haddock, 2 feet 9 inches in length, weighed 10½ lbs., empty.

Three Cuckoo Rays (*Raia miraletus*) were seen on a fish slab on April 11th, the longest one measuring 22 inches. They had been brought in by a steam trawler.

April 12th. About thirty Hooded Crows on a Breydon mudflat. These were a late lot of emigrants; from their actions I judged most of them had paired.

Sanderlings. A very thick fog on Breydon allowed me a very near approach to a number of Sanderlings. With them were Dunlins and Ringed Plovers. The "*wick-wick*" of the Sanderling is most easily distinguishable. Wind, S.E.

On April 20th, I saw two Spoonbills. May 2nd, several Wimbrel on Breydon.

May 6th. An hour and a half's snow this morning!

May 7th. Several Land Dotterel (*Eudromias morinellus*) on the Caister Marshes.

"12th of May—Godwit day!" is a very old local tradition. I went on Breydon to-day but did not see a single example! *O tempora, O mores!* On the 14th, the watcher informed me he had seen a few.

May 16th. A day as gloomy as November. Saw two Swans in a Breydon 'Drain'; and several Wimbrel. In the evening I saw about 50 Herons scattered singly all over Breydon. One grand old bird, with flowing crest, reluctantly rose on three occasions just ahead of my punt as I sailed her up the Ship Drain, the bird alighting each time only a few yards ahead.

The movements of several Lesser Terns (*Sterna minuta*) in May, 1902, were exceedingly interesting. The wind blowing somewhat stiffly on the morning of the 23rd made a dinner on Breydon difficult to find, whereupon they betook themselves, two pairs of them, to one of the ditches on the rear of Suffolk side of the walls. One after another they repeatedly dipped, securing a Three-spined Stickleback at every stoop. I laid hidden in the long grass at the ditch end and so had a capital chance of observing them closely. Several still remained on Breydon on June 2nd, and I felt convinced at least two pairs had intentions of nesting in the vicinity. I at length located a spot evidently selected for that purpose, at that higher portion of mud-flat at the entrance of the Ship Drain. Up

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till the middle of June low tides prevailed, but a higher spring tide washed everything clear of the flat, and the birds disappeared with the exception of one pair; these remained until June 27th. Plenty of Lesser Terns came back to this neighbourhood in August; and it was pretty to watch the old birds catching Herring-fry and feeding their young which remained fluttering and floating on the water.

June 1st. Ringed Plovers in some numbers on Breydon. My small son Gilbert, watching the Ringed Plovers on the shingle patches on the North Beach, discovered two young birds, that, on his stooping over them, squatted flat on the sand; they did not move when he gently lifted them in his hands; and ran away, on being released, in amusing haste.

June 2nd. Several Turnstones on Breydon Very late travellers.

The neighbourhood of Belton, four miles S. of Yarmouth, must be the metropolis of the Natterjack Toad (*Bufa calamita*). It abounds everywhere, on marsh, in market garden, on furzy common. In a sandy bank, creased with deep lines as if done by a stick, on the evening of June 4th, I saw rows of heads peering out; at sundown they come out and patrol the gardens, waging war on slugs and beetles; they are then seen running about from duck's-egg sized individuals to little fellows no larger than Barcelona nuts, all intent on a supper. It is not to be wondered at that nowhere within many miles' radius are heavier crops of strawberries gathered. The country folk treat them kindly; and have evidently learned their worth.

Several blotched and semi-albino Soles, Brills and other flat fish have been preserved for my inspection during the past year.

June 20th. A late Oyster-catcher on Breydon. When well-fed, Gulls sometimes amuse themselves by catching crabs and small flounders that they detect flapping or scurrying in the grass-covered flats when they are resting upon them. On June 19th, several actually captured these creatures, and flying up repeatedly, simply dropped them again as if for the very fun of the exercise; this occurred quite opposite my houseboat.

The following note may be worth quoting as written:—"June 25th. An unusual scarcity of Redshanks on Breydon. Day after day and not a bird is seen. I'm told there is a goodly number up the Beccles River."

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"June 26th. Several to-day near the houseboat."

"July 3rd. Three score around me."

"July 28th. At least 100 on the ground near the boat."

A most unusual number of Lesser Saddleback Gulls (*Larus fuscus*) in various states of plumage on the flats, during the latter half of June.

July 2nd. A young Black-headed Gull pottering about on Breydon.

July 2nd. Picked up the head and three parts of a Stork's skin, floating on Breydon. How it came there I cannot say. Whether thrown into the river from a vessel, or by any bird-interested wag I should not like to venture an opinion. Anyway I saw some unusual object floating in the Duffell's Drain and found it to be as above.

July 4th. Two adult Dunlins on Breydon.

July 11th. A White-beaked Dolphin (*Delphinus albirostris*) 54 inches in length was captured in a herring net, and brought into Yarmouth next day.

On July 30th, a Caspian Tern (*S. caspia*) was observed by Jary the watcher on Breydon. I saw two Little Stints (*Tringa minuta*) on the flats.

I have been gratified in making another addition to the list of Yarmouth Fishes viz:—the Eckstrom's Topknot (*Zeugopterus unimaculatus*). This was given to me in a dried state, in September, 1902, having been kept hung over his mantel-piece by a shrimper friend of mine ever since he took it with his shrimps some weeks before. Knowing my interest in such matters he said he thought he'd keep it till he saw me! It was taken just off the shore, and there is not the least suspicion of untruth in the man's statement. The fish which is new also to the county measured about five inches in length, and was shaped very much after the fashion of a Smeared Dab. The specimen, through the kind offices of Mr. Distant of the 'Zoologist,' was submitted to Mr. Boulenger who at once confirmed my finding.

On October 8th a Porbeagle Shark (*Lamna cornubica*) 8 ft. 3 in. long was landed on Fish Wharf. Another taken in a lugger's nets was thrown overboard at about the same time.

A Smeared Dab (*Pleuronectes microcephalus*) 10 inches long, of the usual colour, had white fins entirely encircling it.

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In the middle of October a number of Shorelarks (*Otocorys alpestris*) were taken.

Nov. 10th. Was quite a Jackdaw day. I saw flocks up to fifty at a time pass over.

On November 18th an example of the Lesser Forkbeard (*Raniceps raninus*) was washed ashore during a rough sea. Length 10½ inches.

On November 23rd. An inrush of Dunlins and other shore-birds, also some Godwits. Wind S.E. strong.

On November 27th. Glossy Ibis (*Plegadis falcinellus*) shot by a wherryman, near Ludham, on the Bure.

1903.

A Shag (*Phalacrocorax graculus*) caught on the beach early in January was brought to me alive, but was so exhausted by want of food and by the buffetings of the waves that it never recovered, dying in a few hours in my aviary. Strong wind from S.E.

During the first week in January a large Seal was seen about Breydon. It was shot at several times, but eventually got away apparently unhurt.

About the 8th January nine White-fronted Geese (*Anser albifrons*) on Breydon.

In February I had a conversation with a lightsman employed on the Outer Dowsing. He told me that in the previous November an unusually large number of Rooks and Crows, with Hooded Crows and Jackdaws, visited the vessel. On one or two occasions during foggy weather they settled on every conceivable place affording foothold—ropes, bulwarks, rigging, lantern, and went to sleep there. He estimated they had on one occasion fully a thousand birds at one time. They knocked them down wholesale. In the morning the decks looked as if they had been whitewashed.

Unusual numbers of Conger Eels (*Conger vulgaris*) with Ling (*Molva vulgaris*) on the fish stalls, latter end of February.

Six Jackdaws took up their quarters in the parish church steeple, early in March, and subsequently some others. I believe they have settled there for nesting purposes. This they did successfully.

Rooks again took possession of the trees in the old disused burial ground behind the Butchery in the market-place. At the time of writing (April 22nd), six nests have weathered the

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storms of March and April and the prospects of a successful hatching seem assured. The persistency of the birds in nesting here after the cutting down of the first nest in 1901, the blowing down of two others in 1902, is interesting to note; and the inhabitants in the vicinity are without exception delighted at the idea of possessing in our midst a permanent rookery. About twenty young birds were eventually hatched off.

Several Prawns (*Palæman serratus*) taken by the early shrimp-boats going out in the beginning of March.

I hear an exceedingly good account of the increased numbers of Lapwings nesting on the Mautby marshes since greater protection has been afforded, and shooting on the Bure altogether abolished. Marshman Smith informs me (April 22nd) that some Lapwings have actually nested on the ronds beside the river, but fears that high tides may sooner or later disturb the sitting birds.

XV.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1902.

By Frank Leney,

Assistant-Curator of Norwich Museum.

Read 31st March, 1903.

During the year ending December 31st, 1902, the additions to the Museum include a beautiful example of the White-eared Cob or Antelope (*Cobus leucotis*), labelled by Mr. Buxton, "Inhabits marsh and jungle. Killed near Kaka, White Nile, March, 1901"; and four heads of other Antelopes, *viz.*, Swayne's Hartebeest (*Bubalis swaynei*), "Sig of the Somalis. Inhabits open grassy plains. Killed, Marar Prairie, March, 1895." Impala (*Æpyceros melampus*) "British East Africa. Killed, August, 1899. Kilimanjaxo." Speke's Gazelle (*Gazella spekei*) "Dhero of the Somalis. Inhabits the Haud Plateau in Somaliland. Killed, Gibili, 1895." Waller's Gazelle (*Lithocranius walleri*) "Gerenuk of the Somalis. Killed, Marah Prairie, Somaliland, 1885." These valuable

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specimens were given by Mr. Edward North Buxton, and form a noticeable exhibit in the animal room. Mr. Geoffrey Fowell Buxton presented a fine head of a Norfolk Ram (*Ovis aries*), and Sir Reginald Beauchamp a buff variety of Hedgehog (*Erinaceus europæus*) taken in Langley Park, Norfolk. Skeletons of Man and Horse have been mounted after the group shown in the Natural History Museum in London. The skeletons were the gift of Mr. A. H. Santy.

Mr. J. H. Gurney added to the collection of Raptorial Birds specimens of *Leucopternis plumbea* and *Tinnunculus sparverius;* he has kindly sent me the following note on *L. plumbea.* "An adult female of *Leucopternis plumbea*, Salv. marked 'Rio Bogota, N. Ecuador, January, 1901,' makes a good pair to the male already recorded, Trans. Norfolk and Norwich Nat. Soc. vol. vii. p. 172. This species was described by the late Mr. O. Salvin in 1872, and has long remained a very rare bird in collections; there appears to be no difference in sex."

Also eighteen birds' skins from South Africa collected by the late Mr. Thomas Ayres, and a White-headed Diving Duck (*Anas mersa*) from Lenkoran. The Hon. G. Lascelles presented a female specimen of Amherst's Pheasant (*Chrysolophus amherstiæ*) which had assumed the plumage of the male, and the Rev. T. C. Hose gave a Tabuan Parrakeet (*Pyrrhulopis tabuensis*) from Fiji Islands.

Colonel Irby presented two cabinets of British Moths, one with twenty-eight drawers containing the Nocturni, Cuspidates, and Noctuas; the other, with twenty drawers, containing Geometers. Mr. Frederick Ringer of Nagasaki presented a specimen of the beautiful Glass Rope Sponge (*Euplectella oweni*) enclosing some small Crustaceans (*Spongicola venusta*), and Mr. John Morgan of Worthing added twelve species to the collection of Corals.

To the geological collection, Mr. G. W. Colenutt contributed some small fossil fishes (*Clupea vectensis*) from Eocene deposits in the Isle of Wight. Mr. T. Fowell Buxton presented the iliac portion of a huge pelvis of *Elephas meridionalis* from the "Forest-Bed" at Overstrand, near Cromer. This bone was discovered by some fishermen at the base of the cliff after a high tide on the 14th of October, 1902.

The general interest in the Museum has been well maintained, as is evidenced by the fact that 118,697 visitors passed through the turnstiles as against 109,249 in 1901.

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Yours very Truly

W. D. Geldart

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XVI.

OBITUARY NOTICES.

Herbert D. Geldart.

1831—1902.

On 21st September last the death occurred, at his residence, Thorpe Hamlet, of Herbert Decimus Geldart, an original member of the Society, the Treasurer for many years, President on three separate occasions (1874—75, 1882—83, 1895—96), and a Vice-President from the year 1875. He belonged to an old Norwich family, and one which took an honourable position in a literary circle which flourished in this city early in the last century.

His official connection with the Society dated from its beginning in 1869, when he served on the first Committee. He read a paper 'On the Division of the County for Botanical Purposes' at the first meeting of the Society, 27th April, 1869. From that date to the year of his death his interest in the work of the Society never abated. His botanical contributions to the Transactions must have entailed an enormous amount of work, and will prove invaluable to all future students of the botany of Norfolk. A glance through the list of papers by him, published in the Transactions, will show, however, that though Norfolk Botany was his principal study, his interests were by no means confined to that county. He had devoted considerable attention to the Arctic Flora and its distribution, in which he collaborated with Colonel H. W. Feilden, C.B., who had brought home collections of plants from Spitzbergen, Russian Lapland, and the island of Kolguev. In a letter to the Hon. Secretary of the Society, Colonel Feilden writes: "His extraordinary general knowledge was combined with such accuracy and exactitude that I never found him tripping in the thousands of references that have passed between us. What I should feel inclined to dilate upon is the great knowledge, perseverance, and unflagging energy with which he worked out, in co-operation with me, the various botanical collections that I brought back from time to time from the Arctic Regions." Mr. Geldart's third Presidential Address, delivered 30th March, 1896

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(vol. vi. p. 119, Transactions), dealt with the whole subject of the Distribution of the Arctic Flora. In this address, a wide acquaintance with the work of others in the same field is combined with his own most interesting views on the permanence of the Arctic Flora throughout the Glacial period.

The lists of Flowering Plants, Ferns, etc., contributed to the Transactions from time to time were all carefully done. A small botanical note, now and then, also showed that a watchful eye was being kept upon any new occurrence or new station for a plant. Those who have had the privilege of looking through the papers and MSS. left by Mr. Geldart will realise how thorough and painstaking his labours were. Nothing relating to the distribution of plants in Norfolk seemed to escape him. His love of plants, however, was such, that in the case of a rare one nothing would induce him to publish a specific locality, through his fear of its leading to the extermination of the plant through ruthless gathering. His friendship with the late Hampden G. Glasspoole, who died in 1887, led to the latter leaving him his herbarium. In addition to this, Mr. Geldart has left a valuable herbarium formed by himself, which is now in the possession of his daughter, Miss Alice M. Geldart.

Besides numerous papers and notes published in our Transactions, Geldart compiled the article on Botany in Mason's 'History of Norfolk,' 1883, a paper on "Botany in Norfolk" in W. A. Dutt's 'Norfolk' published 1900, and the Botanical portion for this county in the Victoria History, Westminister, 1901. It may also be mentioned, that, in the 4th and 5th editions of White's Norfolk, published 1883 and 1890 respectively, Mr. James Britten, F.L.S., acknowledges his dependence on Mr. Geldart's work in his Botanical articles in both these volumes.

He had, since boyhood, possessed a microscope, and had worked assiduously at many of the lower forms of life. His exhibit of *Filaria sanguinis hominis* (*nocturna*) on 30th May, 1893, at a Meeting of the Society, showed that he possessed great manipulative skill in mounting objects for the microscope. A paper on this comparatively rare parasite (in England) was also read the same evening.

We have hitherto spoken of Mr. Geldart only as a Botanist and Microscopist, but during his frequent visits to the coasts he studied its Marine Fauna, and had a considerable acquaintance with the Crustacea especially, a branch which has been so little worked at;

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and although he never contributed anything personally to the literature of the subject, he has from time to time rendered great service to more than one member of the Society who has sought his help in that direction. In fact he was one of those all round naturalists so rapidly giving way to specialists and becoming more and more rare, but his innate modesty led him to confine his published contributions to his favourite subject Botany.

Mr. Geldart's presence at the Meetings of the Society was always a guarantee that any discussion which took place would be enriched from the storehouse of his great knowledge, and raised in tone by his dignified manner of speech. Vague or incorrect statements were promptly challenged by him, and the speaker, kindly but firmly, led to see where the error lay. It is not too much to say that the character of the work done by the members of the Society was greatly influenced by Mr. Geldart's example; looseness of style and superficiality he abhorred; but no genuine searcher after knowledge appealed to him in vain, and his help was as freely given as it was thorough and effectual. A frequent attendant at the excursions of the Society, he was always a centre of interest and a delightful companion.

LIST OF PAPERS CONTRIBUTED BY THE LATE MR. H. D. GELDART TO THE TRANSACTIONS OF THE NORFOLK AND NORWICH NATURALISTS' SOCIETY.

On the Division of the County for Botanical Purposes. 27th April, 1869. Vol. i. p. 19.

President's Address. 30th March, 1875. Vol. ii. p. 1.

Fauna and Flora of Norfolk: Section i. Flowering Plants and Ferns. 23rd February, 1875. Vol. ii. p. 71—80. Section ii., Vol. ii. p. 229.

Ambrosia peruviana in Norfolk. Note. Vol. ii. p. 228.

Pyrola minor. Note. Vol. ii. p. 335.

Notes on the Life and Writings of Edward Blyth. 28th October, 1879. Vol. iii. p. 38.

Additions to Norfolk Flora (Three very rare plants *found by Mr. A. Bennett.*) Note. Vol. iii. p. 268.

The Lombardy Poplar (Its destruction in Norfolk by severe winter of 1880—81). Summary of replies to circular. 31st January, 1882. Vol. iii. p. 354.

President's Address. Symbiosis. 27th March, 1883. Vol. iii. p. 425.

Fauna and Flora of Norfolk: Marine Algæ. 27th March, 1883. Vol. iii. p. 532.

Fauna and Flora of Norfolk: Flowering Plants and Ferns, Additions and Corrections. March 25th, 1884. Vol. iii. p. 719.

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BOTANICAL NOTES, 1884 (from E. F. Linton, A. Bennett and others.) Notes. Vol. iv. p. 142.

BOTANICAL NOTES, 1885. Notes. Vol. iv. p. 255.

NOTES ON PLANTS COLLECTED BY CAPTAIN MARKHAM, R.N., IN HUDSON'S BAY, ETC., IN JULY AND AUGUST, 1886. 25th January, 1887. Vol. iv. p. 354.

BOTANICAL NOTES, 1887. Vol. iv. p. 511.

NOTES ON GALPIN'S FLORA OF HARLESTON. 29th May, 1888. Vol. iv. p. 578.

SPIRÆA TOMENTOSA AND SAMBUCUS RACEMOSA. Note. Vol. iv. p. 689.

FAUNA AND FLORA: FLOWERING PLANTS AND FERNS. Supplemental to previous lists. 26th March, 1889. Vol. iv. p. 711.

BOTANICAL NOTES, 1889. Vol. v. p. 108.

BOTANICAL NOTES, 1890, '91, '92. Vol. v. p. 328.

NOTES ON FILARIA SANGUINIS HOMINIS (NOCTURNA). 30th May, 1893. Vol. v. p. 547.

FAUNA AND FLORA: FLOWERING PLANTS AND FERNS (5th List). Additions to previous list. 27th March, 1894. Vol. v. p. 652.

NOTES ON A SMALL COLLECTION OF SPITSBERGEN PLANTS. By Colonel H. W. Feilden and H. D. Geldart. 27th November, 1894. Vol. vi. p. 47.

PRESIDENT'S ADDRESS. (Distribution of Arctic Flora.) 30th March, 1896. Vol. vi. p. 119.

CONTRIBUTIONS TO FLORA OF RUSSIAN LAPLAND. By Colonel H. W. Feilden and H. D. Geldart. 24th February, 1896. Vol. vi. p. 161.

CONTRIBUTIONS TO FLORA OF KOLGUEV. By Colonel H. W. Feilden and H. D. Geldart. 24th February, 1896. Vol. vi. p. 168.

THE MISTLETOE: ITS HOSTS AND DISTRIBUTION IN GREAT BRITAIN. 31st January, 1899. Vol. vi. p. 453.

The death of the EARL OF KIMBERLEY was a national loss, and his biography belongs to his country, but it is fitting that we as a Norfolk Society should bear our testimony to his worth, and acknowledge the assistance we derived from his long connection with our Society.

The name of Lord Kimberley appeared at the head of our first printed list of Vice-Presidents; in the year 1875 we published in our Transactions a list from his pen of birds observed on the Kimberley estate since 1847, nearly all the species, which amounted to 139, having been seen by Lord Kimberley himself, who was a most observant naturalist as well as a keen sportsman and a good shot; a second list, published in 1888, brought the number to 147.

Sir M. E. Grant Duff has given in the 'Spectator' some reminiscences of Lord Kimberley, and a remark there quoted, shows him to have been much in sympathy with one of the objects of our Society—the protection where needed of our avifauna—"Almost

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the greatest crime," said Lord Kimberley, "which any one can commit on my estate, is to kill an Owl."

While we like to remember that the Earl of Kimberley was eminently gifted with those qualities which go to the making of an English country gentleman, and that he took an active part in the work of the County Council and in all that concerned the interests of his neighbours, we do not forget that he was also a distinguished statesman, the long list of whose services to the State is a record of which Norfolk may well be proud.

The Earl too was proud of his county. On one occasion when speaking of the long connection of his family with Norfolk, he said that he could boast that this had lasted for more than 500 years, and that the Wodehouses had lived uninterruptedly in the same place, from the end of the 14th century, the estate having descended in a direct line during that time. During his tenure of office as Colonial Secretary, the name of the Norfolk village from which he took his title, was given to a spot in South Africa, afterwards to become famous in the world; and though at the time of Lord Kimberley's death the thoughts of men were turned to the last resting-place on the Matoppo Hills of Cecil Rhodes who made it famous, yet the thoughts of not a few were recalled with feelings of affectionate regret to the little church in Norfolk, where John Wodehouse, 1st Earl of Kimberley, had been laid to rest.

Mr. Francis Dix had been for many years a member of our Society and we shall long remember his genial presence at our meetings, and the many pleasant excursions which we have taken, with him as our conductor. Mr. Dix in early and middle life was engaged in farming at Dickleburgh and for thirty-six years from January, 1839, he kept a record of the rainfall at that place, which record was afterwards continued in Norwich, and in February, 1889, he read a paper at our meeting on fifty years' rainfall, and twelve years later he exhibited a chart of the rainfall of the 19th century; his notes on which, with a summary, were also printed in our Transactions. In addition to his interest in meteorology, Mr. Dix occupied much of his leisure in the study of astronomy and the phenomena of electricity. On one occasion he astonished his neighbours by experimenting on the effect on growing crops of the passage of the electric current through wires stretched on the plants, his friends exclaiming in wonder: "Here's Quaker Dix

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mucking his fields with lightning." Mr. Dix lived to a great age, enjoying good health nearly to the last, a member of the Society of Friends, he was much respected and beloved and with him has died out the Quaker costume, once so well known in Norwich.

Lord Cranworth who died on 13th October, 1902, had been for many years well known and deservedly popular in the county in which he had done such active work, especially as President of the County Council. When the new year's honours for 1899 were announced it was felt that none were more deserved than the peerage for Mr. Gurdon. In early life Lord Cranworth had been an active volunteer officer and before his elevation to the House of Lords he sat for twelve years in the House of Commons.

Mr. John Nigel Gurney, who died October, 26th, 1902, was the eldest son of the late John Gurney of Sprowston, to whom the members of our Society owe so much for the munificent and thoughtful care, with which he started the scheme for converting a prison into the splendid building in which the Natural History collections are now housed. Mr. Nigel Gurney, who was born in 1874, was of a retiring disposition and his interest in Natural History was rather that of a sportsman than a man of science, but he was always glad to help forward the work in which other members of his family were actively engaged. At the time of his death Mr. Gurney filled the office of High-Sheriff of the County.

Dr. John Lowe died at his residence, Oatlands Wood, Weybridge, on 12th December, 1902, he had been for upwards of thirty years a member of our Society and had during that time contributed many valuable papers to our Transactions, among which we may mention his lists of Norfolk Fishes and wayside Botany in Norwich. John Lowe was born at The Old Place, Sleaford, and after having been a pupil to his uncle Dr. Harvey of that town, studied at Edinburgh, at which university he gained the gold medal awarded for the best herbarium of Scotch flowering plants. On leaving Edinburgh, where he graduated M.D. with honours in 1857, he took the diplomas of M.R.C.S., Eng. and L.S.A., and commenced practice in Lynn. In 1859 he was appointed honorary surgeon to the West Norfolk and Lynn Hospital, which post he filled until the increase of his private practice precluded his holding it longer. In 1871 he was appointed medical attendant at Sandringham and was

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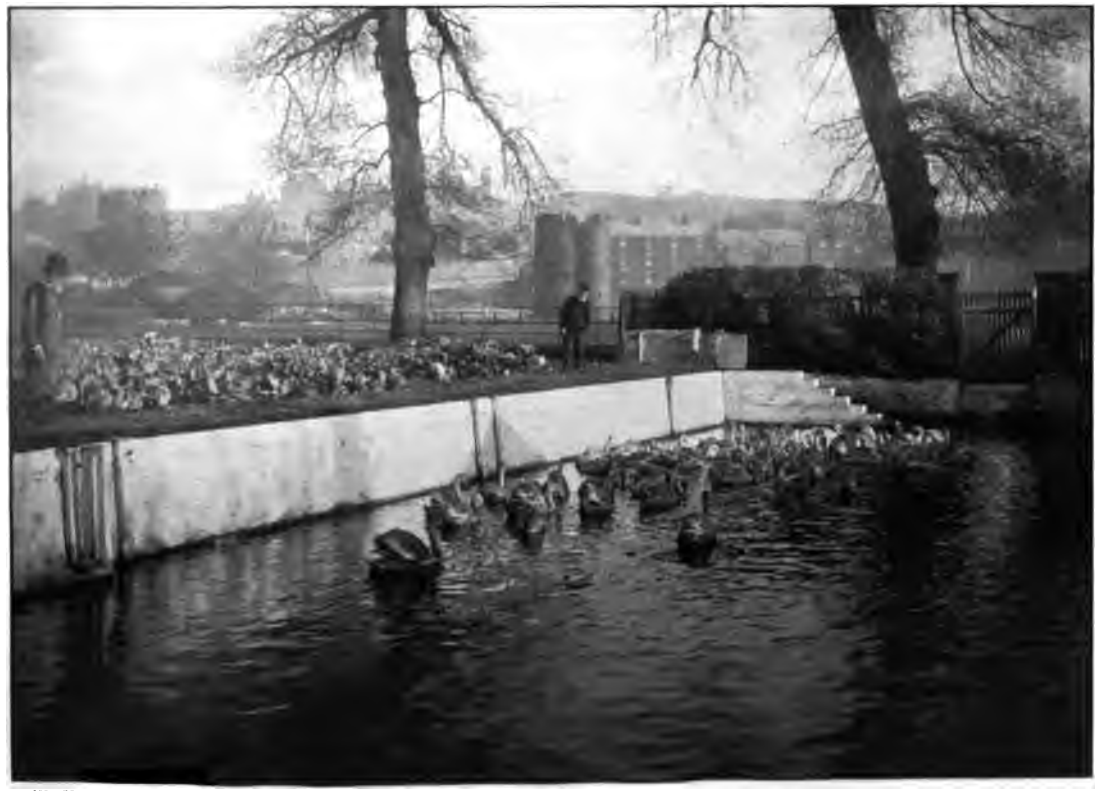

W. H. Bidwell, photo.

ST. HELEN'S SWAN-PIT, NORWICH.

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the first to diagnose the nature of the serious illness of His Royal Highness the Prince of Wales. In 1883 Dr. Lowe was President of the East Anglian Branch of the British Medical Association, in which year the meeting was held in Lynn and on relinquishing practice in that town he resided in London. He was one of the Physicians Extraordinary to the King.

In his early years Dr. Lowe was a frequent contributor to the Transaction of the Botanical Society of Edinburgh, and while resident in Norfolk he devoted much of his scanty leisure to cryptogamic botany, turning his attention to fungi, mosses, lichens and algæ. His best known botanical work is perhaps his book on the 'Yew Trees of Great Britain and Ireland.' He contributed the article on Fishes to the 'Victoria History of Norfolk' and also, compiled a list of the Flowering Plants of West Norfolk.

XVII.

MISCELLANEOUS NOTES AND OBSERVATIONS.

St. Helen's Swan-Pit.—The accompanying view of the Swan-pit at the Saint Helen's Hospital, is from a photograph taken some time ago by Mr. W. H. Bidwell, and as the continuance of this ancient institution has become jeopardised it is thought the members would be glad to possess a copy by way of a possible memento.

The origin of this probably unique establishment, which has already formed the subject of two communications to the Society (*Vide* 'Transactions' vol. v. p. 265 and vol. vi. p. 387*), is lost in the obscurity of the past, but as has been mentioned, the first reference to it hitherto discovered was an entry in the Corporation accounts of a payment to William Bylney of 3s. 4d. for keeping the Swans of St. Giles' Hospital for the year 1487—8, and up to the year of the Municipal Reform Act (1835) a sum of two guineas was annually paid to the "Swanner," since which time the Swans for fatting have been consigned to the care of the master of the Hospital. It

* See also 'Birds of Norfolk,' vol. iii. p. 96.

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is evident that as early as the year 1487 the Swan-pit was a working concern and it is probable that it came into existence as an appendage to the great religious houses, which were possessed of Swan rights, the Cygnets being taken up at the proper season, marked with their proprietors' *Cygninota* and transferred to the *Cygnorum* to be fattened for the table. Of late years, the demand for these fatted Swans has fallen off, many of the former patrons having died and their places not having been filled by others; the dish seems also to have been less favoured or perhaps neglected, and although the numbers sent in in the last two seasons were only fifty-seven and fifty-two respectively, the supply exceeded the demand and resulted in a serious loss to the master of the Hospital whose privilege it was to fatten them, this loss having occurred repeatedly of late he cannot be expected to bear.

It is I believe under the consideration of the Trustees of the St. Helen's Hospital whether some means can be devised for continuing this interesting relic of the past, and it is sincerely to be hoped that so lamentable an event as the extinction of the ancient *Cygnorum* may be averted.

The illustration shows the Cygnets in the Swan-pit which is connected with the river, the rise and fall of which ensures a constant fresh supply of water; the floating troughs near the wall which adjust themselves to the water level; also, near the attendant, the spouts by which the dry food is conveyed to the troughs. The high land in the back-ground is Mousehold Heath, the site of Kett's rebel encampment in 1594, and now occupied by two large buildings the one being barracks for cavalry the other for infantry. The ancient circular building in the foreground is one of the towers which long since formed the defence of the river front of the city and is known as the Cow Tower.—T. SOUTHWELL.

MARTEN CATS IN SUFFOLK.—(Correction of an error). At p. 224, vol. ii., our 'Transactions' in a list of vermin killed on a Suffolk Manor in the year 1811, the number of Martens killed is given as forty-three. As this has been frequently quoted in evidence of the abundance of this animal so late as the year named (notably in the 'Zoologist' for 1891, p. 455, for 1892, p. 20, and in the list of Norfolk Mammals in the 'Victoria History of the Counties,' Norfolk, vol. i. p. 248), I take the present opportunity of correcting what is a very serious and misleading error. Having an opportunity of referring to a file of the 'Norwich Mercury,' I find there published

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the list quoted in the paragraph referred to under date of 21st December, 1811, and the number of Martens is given as three not forty-three, the other numbers quoted are quite correct. In reply to some doubts expressed by Mr. Harting as to the correctness of the number of forty-three ('Zoologist,' 1891, p. 455,) I ventured to prefer a local contemporaneous record to one published by Daniel 'Rural Sports' (Supplement p. 585) two years after, especially as out of three records no two agree (see 'Zoologist,' 1892, p. 20), but at the same time expressed the opinion that "the smaller the number the more likely it was to be correct," which has proved to be the case.—T. SOUTHWELL.

STICKLEBACKS AS MANURE.—In the 'General View of the Agriculture of the County of Norfolk,' by Arthur Young (1804 but referring to a period before 1802), the author writes as follows: "These little fish, which are caught in immense quantities in the Lynn rivers about once in seven years, have been bought as high as 8d. a bushel. The favourite way of using them now, is by mixing with mould and carrying on for turnips. Great quantities have been carried to Marham, Shouldham, and Beachamwell. Mr. Fuller there, is reported to have laid out £400 for them in one year, they always answer exceedingly. Mr. Rogerson, of Narborough, has gone largely into this husbandry, laying out £300 in one year, at from 6d. to 8d. a bushel, besides carriage from Lynn; he formed them into composts with mould mixed well by turning over, and carried on for turnips: the success very great."—T. SOUTHWELL.

ROOKS AND OWLS IN AGRICULTURE.—The following testimony as to the value of these birds to agriculturalists is to be found in Arthur Young's, 'General View of the Agriculture of the County of Norfolk' (1804), p. 531 [Quoted from 'Marshall's Rural Economy of Norfolk' (1787), vol. i. p. 171]. ROOKS. "Seldom attempted to be shot in East Norfolk, where a notion prevails, and is, perhaps, well founded, that Rooks are essentially useful to the farmer, in picking up worms and grubs, especially the grub of the Cockchafer, [which, it is believed, is (*in the original*)] injurious to meadows and marshes.—*Mr. Marshall.* Confirmed in the following note by Mr. Johnson of Thurning: 'I cannot but notice two growing evils with us, of which but little notice is taken:—1st, the number of insects in the lands, owing to the loss of Rooks, by felling so many rookeries, and not taking care of what are left; 2nd the increase of mice, and, were I to give my opinion as to quantity and damage

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done, but few would give credit to it. I have, at different times, had five mice killed to every coomb of corn moved off the stacks in the summer season, and sometimes double that quantity; besides being on every other part of the premises, corn and grass pieces not excepted. Some are driven into the barns and stacks in wet seasons; but when wheat stands long on the shock, we are sure to have most mice in our barns and stacks except where they are driven away by some other vermin:—in my memory there were twenty GREY OWLS, [the Tawny Owl, *Syrnium aluco* (Lin)] where there are now one, and though the country was in a rougher state, we had not so many mice, the owls prey [p. 532] very much on them, and in wet weather they are more exposed to the owl than to any other vermin. The Grey Owl is destroyed by the game-keepers, and by felling the pollards. I have seen a young hare in their nests, but never saw a young pheasant or partridge:—the WHITE OR CHURCH OWL [*Strix flammea* Lin.] are not so destructive to game; and where there are places made within side the top of one end of every barn, like a box, for them to pass through as they come into the barn, they would there make their nests, and become more numerous, and be of great service. (Signed) S. Johnson.'"—T. SOUTHWELL.

NOTE ON THE FLOWERING OF NYCTERINIA CAPENSIS.—In the autumn of 1902 this plant, which was exhibited by me at one of our evening meetings, was flowering freely in a cool greenhouse; and I made observations as to the conditions under which it opened and closed. On September 14th, the flowers unfolded at 3 p.m. and at 4 o'clock were wide open but scentless, at 4.45 there was a slight scent, and strong perfume at 5.30; the pot was then placed in a dark shed, and when the door of this was opened the next morning at 9 a.m. the flowers were all closed. The pot was placed in the evening near an electric lamp, but remained open and at 3.30 a.m. the flowers were still wide open, while at 5 a.m. they were partly closed but scented, and at 6 a.m. quite closed. On 26th September, the morning was bright but cold and some flowers were found open at 9.30 but without perfume, these when held near to the mouth, and breathed on, closed slightly but in the cool air soon re-opened. Two of the sub-divisions of the corolla closed first, when the other three closed over them making little purple balls, the flowers being white when open, these divisions were irregularly sub-divided. When opening, there was some interval

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between the expanding of the flowers and the giving off of the scent, but in the warmer weather the odour would hang about the plant for some little time after the flowers were closed. It would seem therefore that the absence of heat, and not the absence of light, was the cause which influenced the opening of the flowers and the giving off of perfume and the difference in the temperature between night and morning would be much more marked in the Cape of Good Hope which is the habitat of the plant. A telegram describing the difficulties of the march of the British troops in Somaliland, in the desert where Camel Thorns and Mimosa were thinly scattered, gives an illustration of this,—"much of the bush was in flower, burdening the air in the cooler hours with aromatic perfumes."—W. H. Bidwell.

The Siberian Jay (*Garrulus* [*Perisorius*] *infaustus*).—Professor Newton having questioned the determination of the supposed Heron's feather in a nest of the Siberian Jay (*G. infaustus*) in the notes on that species communicated to our 'Transactions' (vol. vii. p. 368), I have carefully re-examined it with the assistance of Mr. Southwell and Mr. Reeve. It is about four inches long, and slightly faded with age, and I find that it comes nearest to the back feathers of a Crane (*Grus communis*), and to that species there is little doubt that it belongs.

This Jay's nest is § 2609 of 'The Ootheca Wolleyana,' vol. i. p. 484, and was obtained in Lapland where *Ardea cinerea* is not found, although it breeds in the south of Norway, and perhaps is not very uncommon at Lesje Vœrk where my companion met with at least one pair of Herons.

It appears from the narrative in 'Ootheca Wolleyana' that a considerable interest attaches to this nest. It was taken in Lapland on April 30th, 1856, by one Peter Nilsson who was hewing wood. He felled a small spruce fir-tree, and on beginning to lop off the branches, saw two Jay's eggs lying on the snow, and then the nest itself among the branches. The *Kuuki* as he terms the bird sat fast although the tree was on the ground, and when Peter drove her off there were still two eggs in the nest: all four are now in the Cambridge Museum.—J. H. Gurney.

Cardamine palustris, Peterm.—Mr. Arthur Bennett has identified a specimen of this plant, which I sent him from the neighbourhood of Norwich, as being near var.: *dentata* Schult. He writes "the plate in Eng. Bot. of *C. pratensis*, L. represents

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C. palustris, Peterm; of continental authors. The true *C. pratensis* L. has radical leaves with five to eight pairs of *sessile* leaflets, which are rounded at the base, but not cordately emarginate, and the flowers are usually white. We in England do not consider that these forms differ sufficiently to constitute a species, so we should name your plant *C. pratensis L.* var. *palustris* (Peterm), f.

According to Mr. Druce of Oxford, *C. pratensis*, L. is rare in England.—F. LONG.

BOX VULGARIS IN NORFOLK.—About the middle of December last (1902), through the courtesy of Mr. Cole, to whom it was sent for preservation, I had the opportunity of examining a specimen of this fish which was found on the beach near Cromer; when fresh it was very beautifully coloured, the back being dark olive green merging into silvery white on the sides and under parts with stripes of a golden colour along the sides below the lateral line the caudal fin a fine crimson, increasing in depth of colour towards the margin—length 9 inches and greatest depth 2¾ inches. This fish, which belongs to the family of Sparidae (Sea Breams) is not sufficiently well known in England, to have acquired a vernacular name but in France it is known as "Bogue." Although it has occurred in a few instances on this south coast of England, I am not sure that it has been recorded so far north as Norfolk, its true home being the waters of the Mediterranean sea, the range extending as far south as the West India Islands. Like most of the southern stragglers to our coast its occurrence appears to be the result of stormy weather. Being for the most part a vegetable feeder, and accustomed to the profusion of marine vegetation covering the rocks of the warmer seas of the south, the sandy shores of our shallow waters would be very unsuitable as a habitat for this handsome species which paid the penalty of its visit to our troubled waters with its life.—T. SOUTHWELL.

THE MOLLUSCA OF A SUFFOLK PARISH (see vol. vii. p. 348). *Additions and Corrections.* Since the above-named paper was written the following species have been found:—

Arion minimus Simroth	*Succinea elegans* Risso
Limax marginatus (Mull)	*Hyalima alliaria* (Miller)

The name of one species recorded before requires correction, for *Pisidium nitidum*, p. 349, l. 27 and p. 352, l. 39, read *Pisidium milium*, Held.—A. MAYFIELD.

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Young J. J. Baldwin, M.A., M.B.O.U.
Richmond Park, Sheffield

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The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year ending March, 1904.

Dr.				Cr.			
1903.	£	s.	d.	1903—4.	£	s.	d.
To Balance from last year	7	11	0	By Fletcher and Son, Limited, *Transactions*, 1902—1903	45	12	0
1903—4.				,, ,, ,, ,, Sundry Printing ...	2	6	0
To Subscriptions:—				,, A. H. Goose, Printing and Stationery	1	13	6
2 for 1901—2 ... ... 0 10 0				,, Postage and Carriage	6	7	2
13 ,, 1902—3 ... ... 3 5 0				,, Insurance	0	9	0
170 ,, 1903—4 ... ... 42 10 0				,, Year Book of Societies	0	6	0
9 ,, 1904—5 ... ... 2 5 0				,, Coe for Lantern at Meeting	1	1	0
48 10 0				,, Norfolk and Norwich Library	1	1	0
,, Additional payments	0	14	0	,, Doorkeeper at Museum	1	0	0
,, Sale of *Transactions*	2	16	1	,, Assistant Secretary's Salary	5	0	0
£59	11	1					
Balance due to Treasurer	5	4	7				
£64	15	8		£64	15	8	

LIFE MEMBERSHIP FUND.

	£	s.	d.		£	s.	d.
1903. To Balance from last year	67	1	4	1903—4.			
1903—4. ,, 6 Compositions for Life Membership ...	24	0	0				
,, Interest to November 20th, 1903	1	17	5	By Balance in Norfolk and Norwich Savings Bank ...	92	18	9
£92	18	9		£92	18	9	

Norwich, 29*th March*, 1904.

Examined with vouchers and found correct,

STEPHEN WM. UTTING, *Auditor.*

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List of the Publications received by the Society as Donations or Exchanges from March, 1903.

BATH Natural History and Antiquarian Field Club, Proceedings of the. Vol. x. no. 2. Bath, 1903.

BERWICKSHIRE Naturalists' Club, History of the. Vol. xviii. Part 1. 1901.

BIRDS, A Hand-List of the Genera and Species of. Vol. iv., by R. Bowdler Sharpe, LL.D. *From the British Museum Trustees.*

BRITISH Association for the Advancement of Science. Information for the Collection, etc., of Photographs of Botanical Interest. *Issued by the Committee,* 1903.

CARDIFF Naturalists' Society. Report and Transactions. Vol. xxxiv. 1901—02. Vol. xxxv., 1903. The Gellygaer Excavations.

CHALK near Royston, Disturbances in the. Reprint from Q. J. G. S., vol. lix., 1903, by H. B. Woodward, F.R.S., F.G.S. *From the Author.*

COLD Spring Harbor Monographs. I.—The Beach Flea (*Talorchestia longicornis*), by M. E. Smallwood. II.—The Collembola of Cold Spring Beach, etc., by C. B. Davenport. Brooklyn. N. Y., 1903. *From the Brooklyn Institute of Arts and Sciences.*

CORAL Gallery, Guide to the. Department of Zoology, British Museum (Natural History). *From the Trustees.*

CROYDON Natural History and Scientific Society. Proceedings and Transactions of. February, 1902—January, 1903.

EALING Natural Science and Microscopical Society. Report and Transactions for 1902—03.

EDINBURGH Geological Society, Transactions of the. Vol. viii. Special Part. The Geological Structure of Monzoni and Fassa, by M. M. Ogilvie Gordon, D.Sc., Ph.D. Vol viii. Part 2.

——— Royal Society of. Proceedings, Vol. xxiii. Edinburgh, 1902.

ENTOMOLOGISTS' Monthly Magazine, December, 1903. *From Mr. J. H. Gurney, F.Z.S.*

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FUNAFUTI Atoll, Report on the Materials from the Borings at the, by George Jennings Hinde, Ph.D., F.R.S. Reprint from the Report of the Coral Reef Committee of the Royal Society, 1904. *Presented by the Author.*

GEOGRAPHICAL Journal, The, including the Proceedings of the Royal Geographical Society. April, 1903—March, 1904. *From Mr. H. G. Barclay, F.R.G.S.*

GEOLOGICAL History of the Broadland, A Sketch of the, by F. W. Harmer, F.G.S. *From the Author*

HANDBOOK of Instructions for Collectors. Issued by the British Museum (Natural History). London, 1902. *From the Trustees.*

HARVARD College, Bulletins of the Museum of Comparative Zoology at. Vol. xxxix.: No. 6, Birds and Mammals from Honduras; No. 7, Carboniferous Fishes from the Central Western States; No. 8, Some Fishes from Australasia. Vol. xl.: No. 6, Polydactylism in Man, etc.; No. 7, Changes which occur in Muscles of a Beetle during Metamorphosis. Vol. xlii., Geological Series, Vol. vi. Nos. 1—5.

——— Annual Report of the Keeper of the Museum of Comparative Zoology at Harvard College, 1902—3.

——— Vol. xlv. no. 1, The Anatomy of *Hemiurus crenatris* (Rud.) Lühe, an appendiculate Trematode. January, 1904.

HULL Scientific and Field Naturalists' Club, Transactions of the. Vol. ii., August, 1902. Flora of East Riding of Yorkshire, by Jas. Fraser Robinson; with List of Mosses, by J. J. Marshall. Vol. iii. no. 1, 1903.

HUXLEY, Thomas Henry. The Scientific Memoirs of. Edited by Professor Michael Foster, M.A., M.D., LL.D., F.R.S., and Professor E. Ray Lankester, M.A., LL.D., F.R.S. In 4 vols. London, 1898—1901. *From Mr. Eustace Gurney.*

IBIS (The) a Quarterly Journal of Ornithology. Vol. iii. nos. 10—13, April, 1903—April, 1904. *From Mr. G. F. Buxton, F.Z.S.*

ICHNEUMONOLOGIA Britannica. The Ichneumons of Great Britain, by Claude Morley, F.E.S. Plymouth, 1903. *Presented by the Author.*

LARGE COPPER (*Chrysophanus dispar*), Notes on, by J. R. Charnley, F.Z.S., F.E.S.. Reprint from Field Naturalists' Quarterly, Vol. 1. *From Mr. J. H. Gurney, F.Z.S.*

LEPIDOPTERA of Southport and District. Pierce and Charnley. Reprint from British Association Handbook, 1903. 12 pp. *From Mr. J. H. Gurney, F.Z.S.*

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LLOYD Library of Botany, Pharmacy, and Materia Medica, Bulletin of the. No. 6 Reproduction Series, No. 3. Materia Medica Americana, D. Schoepf., 1787. Cincinnati, Ohio, 1903.

MANCHESTER Geological Society, Transactions of the. Vol. xxviii., Parts 4—12.

——— Literary and Philosophical Society. Memoirs and Proceedings, 1902—3. Vol. xlvii., Parts 4, 5, 6. Vol. xlviii., Part 1.

MARINE Biological Association of the United Kingdom, Journal of the. New Series. Vol. vi. No. 4. December, 1903.
From Mr. Robert Gurney, B.A.

MARYLAND Geological Survey. 5 vols. Eocene. Allegheny County, Cecil County, Garrett County. Vol. 4. Three cases of maps. The John Hopkins Press, Baltimore, 1901—2.

MEXICO, Boletin del Instituto Geologico de. Numero 15. Mexico, 1902.

MICROSCOPICAL Society, Royal, Journal of the. Parts 2, 3, 4, 5, 1903. Part 1, 1904.

MOLLUSCA of East Suffolk, Notes on the Land and Freshwater, by Arthur Mayfield, M.C.S. Reprinted from the Journal of Conchology. *From the Author.*

MONTANA, Bulletin of University of. A Biological Reconnaissance in the vicinity of Flathead Lake, by Morton J. Elrod, 1902. Lectures at Flathead Lake, 1903. President's Report, 1902—03. Additional Notes on Summer Birds of Flathead Lake, 1903.

MONTEVIDEO, Anales del Museo Nacional de, Contribucion al conocimiento de la Flora Uruguaya. Professor J. Arechavaleta. Montevideo, 1902.

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NEW ZEALAND Institute, Transactions and Proceedings of the. 1902. Vol. xxxv.

NORTHANTS Natural History Society and Field Club, Journal of the. Vol. xi., nos. 89—92., 1902.

NORTH STAFFORDSHIRE Field Club. Annual Report and Transactions. 1902—1903. Vol. xxxvii.

NORTHUMBERLAND, Durham, and Newcastle-upon-Tyne Natural History Soc. Transactions of. Vol. xiv. Part 2.

NOTTINGHAM Naturalists' Society. Fiftieth Annual Report and Transactions for 1901—1902. Fifty-first Annual Report and Transactions for 1902—1903.

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ORNITHOLOGIE Südafrikas, Beitrage zur. von Dr. Emil Holub & A. von Pelzeln. Wien, 1882. *From Mr. J. H. Gurney, F.Z.S.*

OXFORDSHIRE, The Natural History of. Being an Essay toward the Natural History of England by R. P., LL.D. Oxford, 1677.
From Mr. Charles Williams.

PETERBOROUGH Natural History, Scientific, and Archæological Society. Précis of Thirty-First Annual Report, December 31st, 1902.

PLYMOUTH Institution and Devon and Cornwall Natural History Society, Proceedings of the. Vol. xiii. Part 5. 1902—3.

POROSPHÆRA, Steinmann, on the Structure and Affinities of the Genus, by George J. Hinde, Ph.D., F.R.S. Reprinted from Journal of Royal Microscopical Society, 1904.
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RENNES, L'Université de, Travaux Scientifiques de. Tome i. Fascicule 1—3, 1902. Tome ii. Fascicule 1—2, 1903.

——— Histoire de la Faculté des Sciences de, par L. Joubin, Professeur à la Faculté. 1900. 4to. pp. 175.

——— Thèse presentee à la Faculté des Sciences de, par L'Abbe F. Morin. 1er. 4to. 1893. pp. 139.

ROYAL Institution of Great Britain, Proceedings of the. Vol. xvii. Part 1. No. 96. London, 1903.

ROYAL Physical Society, Proceedings of the. Session 1901—1902. Edinburgh.

SCIENTIFIC and Learned Societies of Great Britain and Ireland, Official Year-Book of the. London, 1903.
Purchased by the Society.

SMITHSONIAN Institution, Annnal Report of the. Year ending 30th June, 1902. Washington, 1902.

SOUTH LONDON Entomological and Natural History Society, Proceedings of. 1902.

UNITED STATES Geological Survey. Twenty-second Annual Report, 1900—01. Part 1, Directors' Report, etc. Part 2, Ore Deposits. Part 3, Coal, Oil, Cement. Part 4, Hydrography.

——— Twenty-third Annual Report, 1901—02.

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United States Geological Survey. Monographs. Vol. xliv., Pseudoceratites of the Cretaceous, by Alpheus Hyatt. Vol. xlv., The Vermilion Iron-bearing District of Minnesota, with an Atlas, by J. Morgan Clements. Washington, 1903.

——— Geological Survey. Monographs xlii. and xliii. Professional Papers 1 to 8.

——— Geological Survey. Bulletins, Nos. 191, 195—207.

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No. 209. The Geology of Ascutuex Mountain, Vermont.
No. 210. The Correlation of Geological Faunas.
No. 211. Stratigraphy and Palæontology of the Upper Carboniferous of the Kansas Section.
No. 212. Oil-Fields of the Texas-Louisiana Gulf Coastal Plain.
No. 213. Contributions to Economic Geology, 1902.
No. 214. Geographic Tables and Formulas.
No. 215. Catalogue and Index of Publications of United States Geological Survey, 1902—1903.
No. 216. Results of the Primary Triangulation and Primary Traverse, Fiscal year 1902—3.
No. 217. Notes on Geology of South-western Idaho and South-eastern Oregon.

——— Geological Survey. Mineral Resources of the United States, by David T. Day. Washington, 1902.

——— Geological Survey, Water Supply and Irrigation Papers. No. 65—79. Washington, 1902—03.

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Zoological Society of London, Transactions of the. Vols. xiii., xiv., xv., xvi. 4to. *From Mr. J. H. Gurney, F.Z.S.*

Zoologist, The. A Monthly Journal of Natural History, April, 1903—April 1904. *From Mr. G. F. Buxton, F.Z.S.*

Zoothamnium geniculatum, a New Infusorian, by William Ayrton. Reprinted from Journal Quekett Microscopical Club, April, 1903, with Plate. *From the Author.*

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ADDRESS.

Read by the President, FREDERICK LONG, L.R.C.P., *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-fifth Annual Meeting, held at the Norwich Castle-Museum, March 29th, 1904.*

LADIES AND GENTLEMEN—My year of office, as your President, has now come to an end, and it is my duty in this address to lay before you the different events relating to the Society that have occurred during that period, and to follow this up with a few remarks on some subject of general interest.

During the session we have lost, by death, Mr. Charles Middleton, of Hellesdon, who died on 29th January, 1904. Though not often an attendant at our meetings, Mr. Middleton was known to be much interested in natural science, and more especially in geology. From a very long personal intimacy and friendship at Holkham, I may say that nothing gave him more delight than the finding of a fossil on his farm, and showing it to his friends. During his life he had got together quite a large collection of various objects of geological interest. Many will recall that on 26th October, 1893, the members of the Society were invited to visit Hellesdon in order to inspect a flint implement which had been found on Mr. Middleton's property.

A small party went over under the guidance of Mr. F. W. Harmer, and an interesting afternoon was spent. The implement had been submitted to Professor Prestwich, who considered it palæolithic, though approaching very nearly to the neolithic type, and to Sir John Evans, who thought it was undoubtedly neolithic

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We have also to record the death of the Rev. Samuel Francis Cresswell, D.D., which took place on the 24th inst. Dr. Cresswell had been a member of the Society for many years, but resigned a few months ago. He had been Rector of Northrepps for eighteen years. The deceased was well known throughout Norfolk for his connection with antiquarian pursuits, and he was also no mean scholar. He was a scholar of St. John's College, Cambridge, where he took his B.A. in 1862, his doctor's degree being conferred in 1876. In 1879 he became Rector of Northrepps, on the presentation of the Chancellor of the Duchy of Lancaster. Dr. Cresswell published a number of works of antiquarian interest, chiefly dealing with Nottinghamshire, his native county.

The number of members is now 272, an increase of two during the year, allowing for the loss of two by resignation.

The Treasurer's Balance Sheet, on the whole, shows a satisfactory state of affairs, though the cost of printing the Transactions is a heavy item, compared with the income of the Society. I would suggest that, next year, with the commencement of a new volume, it might be advisable for the Committee to consider the question of the expenditure on the Transactions, with a view to the reduction of the cost.

The books, etc., in the Society's library continue to increase in numbers, not only by exchange with other societies, but largely by donations from members. Mr. J. H. Gurney and Mr. Eustace Gurney have kindly offered to defray part of the expense of preparing a catalogue, and the thanks of the Society are especially due to them. Mr. Eustace Gurney has kindly undertaken the task of compiling a catalogue, and the work is now in a fair way to completion.

For donations of books, etc., we have to thank, in addition to the above named, Mr. Hugh G. Barclay, Mr. G. F. Buxton, Mr. Robert Gurney, Mr. Charles Williams, and Mr. Claude Morley.

The attendance at the evening meetings has shown a slight increase, which I hope augurs well for the future.

On April 28th, 1903, the first Monthly Meeting of the session, your President made some remarks on the subject of the leaf spots

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of *Arum maculatum*, Dr. Plowright sent some specimens of a new Bivalve, introduced from Portugal, and Mr. Leney made some remarks on Bones recently dredged up from near the New Mills, Norwich.

On May 26th your President read a paper on "The Protection of Wild and Rare Plants." Bearing on that at the present, and as the summer is coming on, I would strongly urge upon members the duty of keeping an eye, as far as they can, upon any rare plants in their neighbourhood. Mr. T. Southwell also read a paper on "Some Early Decoys."

There were two excursions arranged during the summer. The first took place on June 24th, and the locality visited was Poringland and Upper Stoke. Amongst other interesting plants found was *Pyrola minor*, L. There was a good attendance of members and friends, and an enjoyable afternoon was spent, under the guidance of Mr. Bussey, who afterwards kindly provided tea for the party at his house. On leaving, one of the members, as he was getting into the wagonette, unfortunately slipped and dislocated his shoulder.

The second excursion in July was to Booton Common. The weather was very unfavourable, and the attendance small; but the common is of some botanical interest which repaid those who took part in the excursion.

On September 29th the President read a paper on "The Causes of the Thick Adventitious Growth on the boughs and trunks of our Forest Trees." Mr. Patterson read his notes on Natural History; Mr. W. G. Clarke exhibited a specimen of the Sooty Tern *(Sterna fuliginosa)*, Mr. F. C. Hinde exhibited an unusual form of the Tiger Moth.

On October 27th Mr. A. Bennett sent a paper on "New Stations for *Liparis lœselii*, Rich. in Norfolk." Mr. W. A. Dutt sent through the Honorary Secretary a "List of Alien Plants from Oulton Broad and Lowestoft." Mr. T. Southwell exhibited Icterine and Aquatic Warblers killed at Blakeney, and Miss Aldis a specimen of the South European Water Tortoise.

November 24th, Mr. J. H. Gurney read a paper on "The Birds

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of the Pembrokeshire Islands." Mr. H. A. Ballance exhibited specimens of Birds and Mammals from South Africa. Mr. W. H. Tuck's Entomological Notes were read. Mr. F. Leney exhibited a photograph of a Mammoth, and Mr. Patterson read some Notes.

January 26th, 1904, a paper on "The Fresh and Brackish Water Crustacea of East Norfolk," by Mr. Robert Gurney, was read, and Mr. Frank Balfour Browne gave an account of Mr. Eustace Gurney's laboratory at Sutton, and a paper on "A Bionomical Investigation of the Norfolk Broads."

Feb. 23rd. Mr. F. Balfour Browne exhibited a living specimen, of the Pond Tortoise, found at Ludham. Mr. Charles A. Hamond gave an account of a "Short Trip to Spain," with Notes on Birds observed. Mr. T. J. Wigg read "Notes on the Herring Fishery" of 1903. Rev. A. Miles Moss exhibited and read a paper on "Moths and Butterflies from Switzerland." Mr. A. W. Preston contributed "Meteorological Notes, 1903," and Mr. A. Bennett a paper on "*Carex paradoxa* and *Lastræa cristata* in Britain."

Last September, following the precedent set by my predecessor, I attended the meeting of the British Association at Southport as your Delegate to the Corresponding Societies' Conference. I have, therefore, to bring before you a few remarks on the subject discussed at the two meetings. The principal subject of discussion was scientific education and the helping forward of it by local scientific societies. Many and varied suggestions were made, and in some cases the officers of local societies gave accounts of the way in which they assisted in educational work. But circumstances alter cases, and I cannot at present see any way, other than an indirect one, by which we can bring influence to bear on the existing educational organizations. Though undoubtedly one of our objects is an educational one, we strive to attain it more by arousing an interest in natural science amongst our own members by means of written papers and mutual discussions, than by taking any direct part in the scientific instruction of the community. The resolution passed at the Conference reads as follows: "That as urged by the President in his address, it is desirable that

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scientific workers and persons interested in science be so organized that they may exert permanent influence on public opinion in order more effectually to carry out the third object of this association originally laid down by its founders, viz., To obtain a more general attention to the objects of science and the removal of any disadvantages of a public kind which impede its progress, and that the Council be asked to take steps to provide such organization." There are two other resolutions passed at a meeting of the Corresponding Societies' Committee in November, 1903, which it is my duty to bring before you.

1st Resolution.—"That the Members of the Corresponding Societies be requested to give as much help as they can to teachers in those Elementary and Secondary Schools which are taking up the subject of Nature Study."

2nd Resolution.—"That the Corresponding Societies be recommended to enter upon the six-inch ordnance maps any unrecorded natural features and archæological remains."

I have chosen for my address the subject of—

PLANT PHYSIOLOGY.

It is only since the latter part of the last century that the study of the physiology of plants has made any great advances, and even now an enormous amount of research work remains to be carried out in order to verify or discard by further experiments the many theories that have been propounded, in relation to the physiological actions of plant life. The whole subject has become so vast and extended that almost any one section would require the lifetime of an observer, and therefore for my present purpose I shall only refer generally to some of the more important heads.

If we regard a herbaceous plant or a tree from the point of view of its being simply a structure composed of trunk, branches, leaves and roots, we get but a very finite idea of it. We may admire a fine tree with its perfect arrangement of branches and leaves; we may be enraptured at the gradual unfolding of a fern leaf; or

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wonder at the odd behaviour of twisting tendrils, but all this fails to satisfy the lover of plant life, and he only gets a half satisfaction. It becomes, therefore, more interesting to dive deeper into the secrets of Nature, and to gain some knowledge of the interior working of the plant organism, how it is built up, by what means it is nourished, and what hidden forces there are at work controlling its growth and development, and under what influences the branches and twigs acquire their various curvatures. All this physiology teaches; and although much has been accomplished, yet as to the causation of the various phenomena witnessed, absolutely nothing is known. We see results, but cannot fathom the how and the wherefore they are brought about. All that is known, is that the different impulses have their mysterious origin in the living protoplasm. A great stimulus to the further study of both animal and plant physiology was given by the publication of Virchow's great work on 'Cell Pathology,' and by the writings of Weissman and others. One great discovery also contributed more than anything to the bringing to light minute organisms and the unravelling of complex structures; I refer to the aniline dyes, for it has only been by means of various staining liquids that accurate knowledge has been obtained. All work now centres in the cell, which may be regarded as the embodiment of the whole structure and physiological attributes of the adult organism. Minute as a cell is, yet as compared with atoms and electrons, which by the discovery of radium have been proved to be actual particles, it stands out as a gigantic mass, itself made up of atoms. By the use of stains, and under the highest powers of the microscope, all its wonderful contents have been brought to light and a physiological importance given to the organs it contains that years ago was not dreamt of. The fertilized ovule contains, in embryo, the elements that go to build up the future plant, and at the same time embraces all the physiological characters that mark the difference between one plant and another; yet under the highest power of the microscope there is absolutely no difference between the oospore of a grain of wheat and that of an acorn.

The fundamental substance of all organic matter, whether animal

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or vegetable, is protoplasm, the only substance of the organism that possesses life, by which attribute it has the power of initiating the various vital processes within the plant. It is generally of a gelatinous nature, of a highly complex composition, and on account of its ever-changing properties according to the requirements of the metabolic processes that are always going on within the organism, its constitution is very unstable. The lowest form of organism, such as an amœba, is simply a mass of protoplasm, without any cell wall, although the external surface is differentiated as a kind of covering. In this state it manifests all the functions of mobility, irritability, digestion, etc., which in the higher organisms are carried on by special structures, such as muscles, nerves, etc. A very important property of protoplasm, and one to which of late much more attention has been directed than formerly, is irritability, the power of responding to any external or internal stimulus. To this I shall refer later on. As we ascend in the scale, the protoplasm forms for itself a covering, the cell wall, and enclosed within this it is termed a protoplast, and has aptly been compared to a Snail within its shell. As the Snail within its covering carries on all the functions of life, so the protoplast by its contained organs develops and carries on the functions for the growth and sustenance of the plant.

The living protoplast, as exemplified in an ordinary parenchymatous cell, is of necessity a very complex body, possessing parts and organs which are of the very highest physiological importance. The principal organ is the nucleus, within which is a fibrillar network which in conjunction with two other bodies termed centrospheres, act a very important part in cell division. Besides these are plastids one or two nucleoli and granular matter. In the main substance of the protoplasm, or cytoplasm as it is called, to distinguish it from the nuclear protoplasm, are bodies termed plastids which when they are coloured green are termed chloroplasts or chlorophyll grains, and other granular matter. In a young cell the protoplasm with its nucleus occupies the whole interior, but as the cell increases in size, vacuoles occur which in the adult cell become merged into one. No increase takes place in the

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amount of protoplasm, but it gradually becomes pushed aside by the expansion of the vacuoles so that it ultimately forms a lining of the whole interior of the cell wall. The vacuoles contain the cell sap and also act as reservoirs for the storage of reserve material. The embryo plant begins its life by the division of the oospore into two, these again into four, and so on, so that by this continued process of cell division the whole structure of the plant is gradually evolved. Several cells united together form tubes whose walls become thickened by deposit of ligneous matter and these of different kinds aggregated together form the various tissues.

In order that a plant may transmit its specific characteristics from generation to generation, it is necessary that in the division of the protoplast, according to Pieffer and others, every organ it contains should divide, each of which by the addition of new growth then becomes complete again. What the limit of this division is, it is impossible to say. It can only be supposed that it extends to the minutest particle of granular matter, for there is no doubt that every such particle possesses some physiological quality of its own which it exercises in a way for some useful purpose of the plant.

There is an important difference between the development of the animal and that of the vegetable. In the animal, certain cells are differentiated for the formation of different structures, such as bone, muscle, nerves, &c., and all these in their multiplication and growth retain the same individuality during the life of the animal. In the seedling plant all the cells are of the same kind, but according to the requirements of growth, cells become differentiated to form, say, a papilla from which it may be, a leaf or a shoot may arise, or the peduncle of a flower, a prickle or a single cell to form a hair. It is this wonderful physiological attribute of the vegetable cell that gives to the plant, other than the conifers, its immortal life. An example of this differentiation of cell growth is shown in stool shoots where, when a trunk is divided, the cambium cells instead of forming wood and bast which they normally do, form a callus from which will spring a shoot, that in time will produce branches, and ultimately flowers, and seeds;

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or as it is in the case of cuttings where from a similar callus roots will take their origin.

Taking a tree as a plant of the highest development, we find it admirably adapted to all the requirements of its nature. The trunk firmly fixed to the soil by its roots, gives support to the branches, which divide up into numerous smaller ones, and these at their extremities give rise to leafy expansions, which are for the purpose of absorbing various gases from the atmosphere, and giving exit to watery vapour. The whole tree is encased in an outer covering, the bark, and in herbaceous plants by a thickened cuticle, both which are perfectly impervious to water, except at the growing ends of the rootlets; and the only parts that give entrance to air are the stomata on the leaves and the lenticels on the young growing shoots.

It is in the green leaves of plants that all their food is manufactured, and the organs that carry on this work are the chlorophyll grains or chloroplasts, and the active agent is the chlorophyll. Those plants that have no green leaves, such as some parasites, saprophytes and fungi, obtain their food already formed, from their hosts, or from decaying vegetable or animal matter. The substance that forms the greatest proportion of the food of plants is carbon which is formed from the decomposition of carbonic acid of the air. It was formerly held that this gas in conjunction with salts and other substances obtained in solution from the roots, was assimilated at once by the protoplasm, the carbon being fixed and the oxygen set free; but that is not exactly true. What takes place is this:—Under the influence of light, carbon dioxide and water are decomposed by the chlorophyll and a carbo-hydrate,—some form of sugar—is formed; part of this becomes dissolved in the cell sap of the vacuoles, whilst a residuum is almost at once converted into starch grains, which remain in the chloroplasts a few hours as reserve material, for it all disappears during the night. At the same time oxygen is liberated and escapes by the stomata. Although carbon dioxide only exists to the amount of 1 or 2 per cent. in the atmosphere, yet from the enormous area of leaf surface exposed and from the air being in

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constant motion, a sufficient supply is always obtained. As starch granules are always found in the chloroplasts, it was thought that that substance was the first product of carbon dioxide decomposition, but subsequent research has proved this not to be the case. Whenever starch is found in a plant it is as reserve material, and before it can be utilised, the grains being insoluble and consequently unable to pass through cell walls, it is reconverted into some form of glucose and in this state is able to be carried in solution to all parts of the plant. An example of this is seen in the potato, where the starch that is formed in the leaves is converted back into glucose which is then carried by the stem to the tubers, where it is again reconverted into starch, and is stored up for the future use of the young plant. With regard to the nitrogenous substances, it is not at present known exactly how or where they are formed. Probably the first steps in the process commence under the influence of the chloroplasts, and then in conjunction with nitrates absorbed from the soil, further elaboration takes place in other parts. The formed material is conveyed by osmosis from the leaf through the parenchyma of the petiole to the cambium district, *i.e.*, between the bark and the wood, whence it is distributed as food throughout the plant; some of it to be utilised, whilst some is conveyed away as reserve material to be stored in roots, winter buds, seeds, &c. The assimilation of carbon dioxide is carried on solely in the chlorophyll apparatus of the leaves, the chloroplasts are the laboratories and the chlorophyll is the active agent which under the influence of light brings about the decomposition. The energy therefore made use of is derived direct from the sun, but photosynthesis is brought to a standstill if the light is too bright, for the action is carried on much more actively in subdued light. Up to the present it has been found impossible to ascertain the composition of chlorophyll, on account of its great readiness to break up in any attempt to isolate it. The chloroplasts owe their green colour to the presence of iron, for if this metal is not supplied to the plant the chloroplasts are not coloured, and if they are not coloured, they are unable to effect the decomposition of carbon dioxide; and yet iron does not enter into the molecule of the

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chlorophyll. There is a strong resemblance between chlorophyll and hœmatin—the colouring matter of hœmoglobin of blood cells—but in the case of hœmatin the iron is in chemical combination with it. The iron in hœmatin can be extracted and a derivative is obtained termed hœmatoporphyrine, which shows a strong similarity to a derivative of chlorophyll called phylloporphyrine. Some interesting results have recently been obtained from experiments by Schunke and Marchlewski from solutions of these two substances. The ethereal solutions are both the same colour, and the spectrum of both is precisely the same, each showing nine absorption bands, all of the same width and depth. Now this similarity between hœmatin and chlorophyll is very remarkable, for both substances are concerned with the interchange of gases in the metabolic changes carried on in proteids, and both are dependent in some way upon the presence of iron for giving effect to these actions, although in the one case the iron is in chemical combination, whilst in the other it is only in what might be termed an imbibed state. As a result of these experiments some clue will probably be found for an explanation as to the precise physiological action of this remarkable substance.

On account of the fixed position of the plant as compared with that of the animal, it is entirely dependent for its food upon its immediate environment, whilst the animal has to go in search of its food and on this account is furnished with certain organs of locomotion. Now in the matter of food, the animal, and when I say animal, man is of course included, is entirely dependent upon the plant for its supply. At the same time that the plant is manufacturing material for its own sustenance, it is also providing the food that will eventually be consumed by the animal. The animal has no power of manufacturing itself any food material, and can only convert to its own use, by chemical and other aids, the material that it obtains from the plant; and so it comes about that, marvellous as it may appear, every bit of food we eat, whether vegetable or animal, has been manufactured originally, directly or indirectly, in the chloroplasts of leaves. Many other substances are formed within plants which are not required as food, some of

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which are cast off as waste products, such as various alkaloids, acids, gums, resins, &c. Others however, are useful in the general economy of the plant, such as nectar for the purpose of attracting insects. In order that a plant may be vigorous and strong it must obtain energy to enable it to carry on the various functions of cell growth, secretions, &c. This can only be supplied by oxygen. There is never a state of equilibrium in a plant, but metabolic processes are constantly at work. Atoms of protoplasm are always breaking down, and as often being built up again. The carbohydrates and proteids of the formed material are also constantly disintegrating and new combinations being formed.

All these actions are brought about by the assimilation of oxygen and the setting free of carbon dioxide, which on account of its poisonous nature is thrown off by the plant and escapes at various points, by the stomata of the leaves, the flowers, and probably by the roots. These metabolic actions, in which oxygen is assimilated, are termed respiration, and are in constant operation throughout the whole plant; but inasmuch as the chloroplasts are inactive in the absence of light, the exhalation of carbon dioxide is more manifested at night. On the return of light, when the chloroplasts again become active, a certain amount of the respired carbon dioxide is utilized again in photosynthesis. We must remember that these chemical processes that go on in the plant are not simply physical, but they have their origin in the living protoplasm, and are vital and physiological. If the protoplasm is not supplied with oxygen, none of these metabolic processes take place, and the plant ceases to live.

A plant, like an animal, cannot live without water and plenty of it. It is essential for perfect health in a growing plant that all its living cells should always be in a turgid condition, in order that dissolved food material may freely diosmose from cell to cell, and this can only be ensured by a constant supply of water from the roots. The liquid taken up by the roots is pure water, holding in solution certain mineral salts derived from the soil, and it is absorbed by the root, hairs and cuticular cells of the terminal growing rootlets; it is forced under root pressure into the wood tissue, and

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is then conveyed upwards through the alburnum or sapwood to the fibro-vascular bundles of the stalks and veins of the leaves. From there it is drawn off by a layer of cells surrounding the bundles, and is distributed throughout the leaf. On account of the continued pressure, the water transudes through the walls of the turgid cells into the intercellular spaces, and escapes from the stomata as watery vapour. In this way a current is set up, which is termed the transpiration current. The main use of this current is for keeping the leaves moist and cool, as otherwise on very hot days they would desiccate and die. On hot days, and especially if the air be dry, transpiration is very active; whilst if the air is cool and contains moisture, very little transpiration goes on. But here a physiological factor comes into play. If the cells of the leaf were simple bladders the water would transude so completely that the cells would soon be emptied; but their walls, as we have seen, are lined inside with living protoplasm, and this has a controlling effect over the amount of water that escapes; and besides, as soon as the guard cells of the stomata become flaccid, they approximate together and close the orifice. The leaves of plants are specially concerned with the interchange of gases, and play very little part in the absorption of water; even after a shower of rain very little, if any, water is taken in. The part where absorption does take place is probably along the course of the veins. A flagging leaf may absorb just sufficient water to revive it, but not enough to render the cells turgid, even if the plant be in a moist atmosphere. A return to turgidity can only be brought about by the supply of water to the root. Many plants, however, such as mosses and lichens, freely absorb water by their surfaces, and recover very quickly after a little rain or dew, even though they had been perfectly desiccated. On a hot day the leaves of a succulent plant, such as a turnip or cabbage, will flag from excessive transpiration; but as night comes on, the stomata close on account of the cold air, and the warm soil causes an abundance of water to be absorbed by the roots, the pressure of which is so great in the cells of the leaf that they are in danger of bursting. This, however, is prevented by the water transuding through the

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closed ends of the fibro-vascular bundles of the veins, when it appears as drops fringing the margin of the leaf.

The power of resistance by plants to very low temperatures is entirely dependent upon the amount of water they contain. The leaves of evergreens hold very little water during winter, and winter buds at the same time possess only a minimum quantity, whilst they are well protected by impervious scales, which act as useful shields, but every plant has a minimum of temperature below which it would be killed. When in America, I was told by a peach farmer that peach trees in the open orchard would withstand a temperature of 5 degrees below zero; but below that, many would be killed. Now I think that peach trees here in England in the open would succumb long before that temperature were reached; and the explanation is, no doubt, that the winter buds and stems are much more desiccated there in autumn, than they are here in our moister climate. So long as seeds and buds are perfectly dry, they can withstand the effects of very low temperatures; but as soon as they absorb moisture and growth commences, the young cells have no power of protecting themselves and the leaves perish at the first frost. Hardy succulent plants, however, have rather a hard time of it, but some of them possess certain protective means by which their destruction is prevented. It is interesting to note how such leaves as those of the dahlia, artichoke, etc., are killed by the first frost, whilst those of some equally succulent kind take no harm, and are able to withstand a prolonged period of frost. As the cold increases contraction takes place, a portion of the water of the cell sap escapes through the cell walls into the intercellular spaces, and freezes in crystals on the outside of the cell wall; the other portion which is in close combination with the cell contents—water of imbibition—does not freeze, at least not until a very low temperature is reached. On returning to a normal condition again, if the thaw be gradual, the water that has frozen on the outside of the cells slowly diffuses back, and they recover their turgidity; but should the thaw be rapid, the water will be prevented from slowly diffusing, and as a consequence the leaf tissue will become broken up and the leaf

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destroyed. This conservative action is not confined to leaves, but takes place also in stems. In the case of other leaves which blacken at the first frost, there appears to be some physiological condition obtaining in the plant, by which this conservative action is not brought about, and probably the cells are ruptured from the first, and the destruction of the leaf takes place at once.

In herbaceous plants and trees of moderate height, water is conveyed to the leaves under the force of root pressure, and its path of transit is through the fibro-vascular bundles in the former, and the younger portions of the wood in the latter, but by what force it is carried to the tops of high trees, is not at present known. A great many experiments have been made, but as yet the problem remains unsolved. It was held by Sachs that water travelled by imbibition through the walls of the wood cells. Now no doubt the force displayed by a body absorbing water is tremendous, for dry peas, as they expand under the influence of moisture, have been shown by Hales to be capable of raising a weight of 160 lbs. Against this theory is the fact that a very little force would stop the flow, and, moreover, when transpiration was active, the necessary quick supply could not be maintained. Another theory was, that the water is conveyed through the hollow tracheal tubes; but the difficulty involved here, is the presence of air which would divide up the columns. Still, as it is easily shown that in herbaceous plants the tracheids are always full of water, it may be proved perhaps in time that these are the channels. There is no doubt that a strong sucking action goes on in the leaves, and this would contribute a good deal to sustaining the rising columns.

Besides the physiological effects, water contributes powerful mechanical aid to a plant. In the normal state the cells, as we have seen, are in a state of extreme turgidity, and the osmotic force is very great in leaves and succulent stems. This force maintains their stability until the woody tissue has developed sufficiently to act as the natural support. It is by the temporary loss of water that the leaves and leaflets of the sensitive plant, *Mimosa pudica*, droop on the application of a stimulus. When a leaf is touched, a physiological response is conveyed to some

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layers of cells on the under part of the pulvinus, the cushion-like expansion of the base of the petiole of leaves. These cells almost immediately lose their water, and the leaf falls down. In the case of the leaflets, it is the cells on the upper part of the pulvinus that are affected, and the leaflets approximate each other.

During the growth and development of plants, a great many physiological actions play their part, and we have to consider what the determining forces are that enable plants to assume certain forms, and how it is that some plants, on account of their inability to maintain an upright position, and lead an independent life, have to seek the help of others or some other support. Every plant in its start in life has an innate feeling of its own proportion and character, and is able to call into play, as it requires, those regulatory forces that will give the required result. The physiological outcome of all these forces is due to the vital property of irritability possessed by the protoplasm. The living cells of a plant are all united into one sympathetic whole by the connecting threads of protoplasm, which penetrate the cell walls, and which were first demonstrated by Gardiner. By reason of this arrangement, sympathetic responses to any stimulus are noted and conveyed to any part of the organism.

The various stimuli that act upon an organism are, light, heat, chemical actions, and gravity, and in addition, wounds, some salts, as potash, and many others. Gravity exercises the greatest force in the development of a plant, and, in order to counteract this force, climbing plants have to employ certain expedients in the form of sensitive organs, that are ready to respond to an external stimulus. Examples of this are seen in the petioles of Clematis, and the tendrils of leguminous plants. It is only one half of the tendril that is sensitive, and this enables it to embrace tightly the support. The tendril of Ampelopsis is only sensitive at the end, and from the sustained stimulus of pressure, a sucker is developed which gives a firm support. We may complain of the prickles of brambles, but it is only by the help of these, responding to the stimulus of touch, that the stem is able to attach itself to supports in its struggle through

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the thicket. These various devices counteract the force of gravity which otherwise would keep them upon the ground. The results of a stimulus are often not manifest for some time. In a growing stem, branches extend out at all angles from the trunk, and from each other, and under the stimulus of light tend outwards and upwards. For a certain length a branch or twig may have a downward (geotropic) curve, due to the stimulus of gravity, whilst another will show an upward (heliotropic) one. These two curves later on may be replaced by opposite ones. Now, although the trend of the branches is towards the light, gravity is always acting as a regulating force, and pulling in opposition to the sunlight force, thus fixing the required position. At the same time, according to the necessities of the plant, these various curves are fixed by a thicker deposit of wood taking place on the upper or lower surface of the branch. Various stimuli play their part in causing the different curvatures. A physiological alteration in cell development may take place, induced by some chemical stimulus, at the growing point of the shoot, which will cause the shoot to start at a different angle. The opening of the bud may be checked by stimulus of cold, or it may be excited by that of light and heat, although all will not be affected in the same degree. A scarcity of water at the root may act as a stimulus, and response to this will be sympathetically conveyed to the growing points. By these various stimuli always at work, but ever varying as to time and action, the tree or shrub is developed, according to a fixed standard of form, that has its physiological value in the inherent nature of the plant.

It is by no haphazard coincidence that some branches and twigs bend in one direction and some in another. As they sway about, the plant acting under the stimulus of the motion, keeps a watchful eye over those parts that require special stiffening. According to the vital necessities from within, it co-ordinates and brings under subjection and into their proper places all the branches and twigs until a perfect and harmonious whole is established.

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I.

PROTECTION OF WILD PLANTS.

By F. Long, L.R.C.P., President, N. & N. Nat. Soc.

Read 26th May, 1903.

About the end of last April our Honorary Secretary received a communication from Mr. C. Callaway, the president of the Cotteswold Naturalists' Club, relative to a subject which is of great interest to every naturalist, viz.: the preservation and protection of wild plants.

An association for this purpose already exists in Devonshire, and is the first one of its kind, and from the account given in the Report to which I shall have occasion to refer, seems to be in active operation.

A movement is now on foot in Gloucestershire for the purpose of forming a similar association, and the Cotteswold Naturalists' Field Club was asked to give their advice and approval. A committee of the Club was appointed which thoroughly investigated all the facts and heard the various opinions of different people interested in the matter. Mr. Druce of Oxford was consulted, and one member of the committee went into Devonshire to ascertain everything as far as he could about the working of the association. The result was that a report of the committee was drawn up which the Club adopted, and passed resolutions based upon it.

At present the law is very inadequate to put down the pilfering and taking of wild plants, and so long as a man does not do damage to the land, fences, &c., to the value of sixpence, he cannot be prosecuted.

Lord Avebury is interesting himself in the matter and Mr. Druce has had one or two interviews with him, and the latter thinks that the framers of any Bill would have their hands much strengthened if they received resolutions passed by

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the principal Natural History Societies throughout the country for the purpose of getting the law amended. He also asked the secretary of the Cotteswold Society to obtain these resolutions for him when possible.

It will now be for our Society, after I have given the details of the Report as approved by the Cotteswold Field Club, to discuss the subject in its bearings on the county of Norfolk, and to pass any resolution or resolutions, which can then be forwarded to Mr. Mellersh, the secretary of the committee.

In their report, the committee considered that if an association were formed, there was no reason why it should necessarily be formed on the lines of the Devon one, and thought it much better that they should adapt lines of their own for the reason that the two counties did not in any way compare in plant distribution, and that what applied very forcibly in one would be of no avail in the other.

The association in Devonshire consists of a Society of which each member subscribes to a common fund which is used for paying a man to conduct prosecutions, paying watchers, &c. They also solicit the aid of editors of papers to give publicity to facts bearing on the general question.

In coming to any decision whether or not an association should be formed here in Norfolk, I think it will be necessary first to ascertain, as the Cotteswold Club did, whether there is much professional plant stealing going on in the county. That a certain amount goes on is only too evident. What are the principal kinds of plants taken and whether any of the rare plants get into the bag of the professional stealer and so should be protected. The only plants I think that are taken in this way are Ferns and Primroses, the former chiefly from the district comprised in about a ten-mile radius of Holt, the latter, of course, from all parts. The professional stealer takes those plants that he can readily dispose of to people with gardens, and in the case of Ferns, the worst of it is, he takes them in the spring when there is no chance of their living after being transplanted, and they ultimately die and are lost altogether. The rare plants of the county are chiefly dear to botanists, and are hardly known to the tramp. Still there are a few exceptions.

In Devon the only plants taken are Ferns and Primroses, and

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in the case of the former, the association seems to have brought the present law to bear upon the stealers, on account of the great number of them, when the necessary damage to uphold a conviction has been proved.

In Gloucestershire, Ferns and Primroses are comparatively rare and only exist in the north-western part of the county; to these might be added, Daffodils, Fritillaries and Lilies of the Valley; but in the present state of the law the Club consider that it would be useless to attempt the formation of an association as only tending to give rise to ridicule, and to frustrate any future endeavours that might be made.

The other class of offenders are villagers and trippers, and it is easy to understand that in some places rare plants are known to grow and that they are dug up and taken away by the latter. These areas under a new law might be protected by notices posted about saying that such and such plants are not to be taken under penalty. Of course the picking of flowers to a moderate amount does no great harm, it is the wholesale rooting up that does the damage.

Botanists, I am afraid, would come under the spell of the new regulations, but as Mr. Druce remarks, he has never known any real harm done in this way, instancing the cases where some plant exists in only one place in the kingdom and still remains. Botanists, I think, will take good care that a species does not become extinct, and will take the necessary measures to protect it.

In demarcating localities for protection, it would not be advisable to have too many, as I think it would appear to savour of rather a grand-motherly protection and might produce ridicule.

There is the other side of the question, viz.: that the very fact of demarcating a certain locality on account of a rare plant, probably only known to be rare by botanists, would tend to excite undue interest and bring the plant into evidence before the public and so hedge it in with danger, whereas if left alone, no one is wiser as to its being a rare plant. Many of the members, I think, can bear witness to this.

Besides these preventable causes of the destruction of wild plants, there are some unpreventable, but which by timely notice, botanists might be able to check, and Mr. Druce gives

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instances where the planting of Larches has entirely destroyed *Anemone pulsatilla*, the sowing of coarse grass seed in the place of the fine turf on the Downs has destroyed the Spider Orchis. Building on Boar's Hill near Oxford has destroyed the site of the rare pink—*Dianthus prolifer*. Near Methuen in Scotland, Sea-gulls suddenly took to nesting and so destroyed *Scheuchzeria palustris*, and many other causes of destruction may be mentioned, such as breaking down of the edges of quarries, trimming of road-sides, &c. In these cases of course the law would be of no avail.

The general conclusions at which the committee arrived were, that the law requires amending with a view to the preservation and protection of wild plants, and in order to strengthen the hands of the framers of any Bill, that the details of such Bill should be laid before the principal Naturalists' Societies in the country for their consideration. Then, in the event of the law being amended, that application be made to public bodies and landlords asking that certain areas may be considered as protected. That when threatened destruction of any plant is likely to occur, botanists should remove the plants to a safe place when the conditions of soil, &c., are the same; that they should take seed and sow it about the spot where any rare plant grows so as to keep up the stock, or raise seedlings and plant them about. These remarks represent the gist of the Report as drawn up by the Cotteswold Naturalists' Field Club.

I am not aware that at the present time there has been any suggestion from any quarter, as to forming an association in this county, and therefore it will not be necessary to discuss the working of one, excepting that whenever the time comes, I may say that Mr. Southwell will be able to give valuable advice, inasmuch as he was chiefly instrumental in defining the areas for protection under the "Wild Birds" Act.

I think it will be the general wish of this Society to record their feeling as to the desirability of getting the law amended, so that measures may be taken either by themselves or by any association that may subsequently be formed for the protection of rare and other plants in the county of Norfolk.

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II.

ON SOME EARLY DUTCH AND ENGLISH DECOYS.

By Thomas Southwell, F.Z.S., V.-P.

Read 26th May, 1903.

In the year 1844 the Chetham Society published a very interesting diary of two journies,* the first undertaken in the year 1634 through the United Provinces of Holland, and the second in the following year, 1635, through parts of England, Scotland, and Ireland, by the same person. The volume of MSS. containing these journals consists of sixty rather closely written leaves, bound together in a parchment cover; it is not signed, but the Editor of the contribution to the Chetham Society considers there is sufficient evidence, internal and otherwise, to show that without doubt the writer of the MSS. was Sir William Brereton, of Handford, in Cheshire, the great Parliamentary General, whose exploits in the distracted period which was soon to follow "are inseparably interwoven with the history of his native county."

I wish to call attention to this journal, as published, first because it contains some interesting information with regard to Decoys early in the 17th century, some of which, for instance, those at Handford; two at or near Newcastle; and "Orion's" Decoy at Bridgwater appear hitherto to have escaped the notice of writers on the subject—and secondly, owing to the volume in which it is published not being readily accessible to the general reader. There is evidence not only that Brereton at this early date worked his Decoy with the appliances and in

* Remains | Historical and Literary | Connected with the Palatine Counties of | Lancaster and Chester | published by | The Chetham Society | Vol. i. | printed for the Chetham Society | M.DCCC.XLIV. | [small quarto].

Travels | in | Holland the United Provinces | England, Scotland | and Ireland, M.DC.XXXIV.-M.DC.XXXV. | By | Sir William Brereton, Bart. | Edited by | Edward Hawkins, Esq. | F.R.S., F.S.A., F.L.S. | printed for the Chetham Society | M.CCC XLIV.

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the fashion which has survived to the present day, but also that he imported a Dutch decoyman to superintend the work, indicating that the art was at that time better understood by the natives of the Low Countries than in England. The employment of foreigners for this purpose may not have been unusual at that time, for we find that King Charles II. employed a Dutchman named Sydrach Hilcus * in the same capacity in 1665, and that professional Falconers were introduced for a like reason. It would also seem that the same rigid seclusion was maintained, and mysticism observed in Holland at that time in the practice of decoying as prevailed long after in this country.

Sir William Brereton was a scion of an ancient and distinguished family, whose chief seat was the Manor of Brereton in Cheshire, with branches in Wales and Ireland; the Norfolk family of Breretons is also descended from Sir Randle Brereton of Malpas. The Sir William Brereton in question—for the christian name of William was frequent in the family—was born at Handford in or about the year 1604, was created a Baronet in 1626; he represented Cheshire in the Parliaments convened in the 3rd and 15th and 16th of Charles I., and greatly distinguished himself, as has already been said, in the wars of the Commonwealth. On the conclusion of Peace he did not go unrewarded, but received liberal grants of money and land, including the Archiepiscopal palace of Croydon. In allusion to this, in an old pamphlet published in 1663, entitled "The Mysteries of the Good Old Cause," he is described as a "notable man at a thanksgiving dinner, having terrible long teeth and a prodigious stomach, to turn the Archiepiscopal Chapel at Croydon into a kitchen; also to swallow up the palace and lands as a morsel." In Sir F. Dwarris's "Observations upon the History of one of the old Cheshire Families" † he thus speaks of Sir William Brereton: "He sedulously collects information upon the subject [of ducks and decoys in his travels] in Holland, and contrasts, with the chuckle of conscious superiority, foreign ponds and decoys

* See 'Handbook of London' vol. ii. p. 434, as quoted by Payne-Gallwey, 'The Book of Duck Decoys,' p. 126.

† 'Archæologia' vol. xxxiii. p. 77.

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with his own in Cheshire." * Now in a letter to † Sir Thomas Aston, "at the beginning of the troubles," which communication relates to the mutual attempts of the contending parties to secure magazines, allusion is thus made by the Royalist writer to Sir William Brereton's taste and indulgence in this particular diversion. "You know what a spirit he is of, and having a company of Roundheads about him, may much advantage him about Chester; he is so near his *Decoy*, that he may send out his Ducks every way to fetch others." ‡ Notwithstanding these facetious remarks, Brereton is spoken of with great respect by all the Cheshire historians, and the authority quoted above in referring to his action with regard to the presentation of Lord Derby's petition to Parliament bears testimony to his "noble nature" in the following terms: "However fiercely opposed to Lord Derby in the conflict of that day, Sir William Brereton, to his honour, does not seem to have forgotten that the Breretons had been among the most conspicuous followers of the Stanleys at Bosworth and at Flodden Field. Sir William Brereton evidently recalled those former ties to remembrance in the hour of victory; and with the generosity of a noble nature, used his exertions in favour of the vanquished" (*l.c.* p. 77). It was the fate of Brereton during that unhappy civil war to be opposed to and instrumental in defeating his near connections of the Byron family, and Michael Drayton's pathetic lines on the battle of Blore Heath aptly describe this brave but unnatural strife:—

> There Dutton, Dutton kills; a Done doth kill a Done;
> A Booth, a Booth; and Leigh by Leigh is overthrown;
> A Venables, against a Venables doth stand (625)
> And Troutbeck fighteth with a Troutbeck hand to hand;
> There Molineux doth make a Molineux to die;
> And Egerton, the strength of Egerton doth try.
> O Cheshire wert thou mad, of thine own native gore
> So much until this day thou never shedst before! (630)
>
> *Polyolbion 22nd Song.*

* In this the Editor is in error, for the comparison was almost always to the disparagement of the English decoys.

† Sir Edward Fitton, of Gawsworth, Cheshire, Bart., dated 27th June, 1642, to Sir Thomas Aston, another Cheshire Bart., at his lodgings, York.

‡ See "Military proceedings in Lan." during the Great Civil War. Chetham papers No. 2 (1844).

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Brereton died on the 7th April, 1631, shortly after the Restoration, and was buried at Croydon. The Baronetcy became extinct in the year 1673. It is stated that the intention was subsequently to remove his body to Handford, but that in crossing a river the coffin was swept away by the flood and apparently not recovered.*

It seems uncertain when the English word "Decoy" was substituted for the Dutch "Kooi" or Coy, always used by Brereton in writing of these duck-catching devices, and its derivation in that sense has given rise to much discussion. By some the word decoy has been thought to be a compound derivative of the article "de" (the) and the Englished form of the Dutch Kooi (Latin, Cavea=a hollow enclosure, or cage) forming de-coy, *i.e.*, the Coy. Others favour the employment of the latter portion of the Dutch *eende* in *eende-Kooi* (duck-coy) as a prefix (the first syllable being dropped), but either derivation seems fanciful and unsupported by evidence. The word decoy was certainly in use in the English language both as a substantive and as a verb, indicating a swindler, or sharper, and the practices of such a person, long before the Dutch word was imported (a game with cards was so named in 1550) and as suggested by the Editor of the "New English Dictionary" it is possible and indeed probable "that the Coy was made into Decoy under the influence of that earlier word." The word "Coy" seems to have little to recommend it to English ears, save its brevity, and it would doubtless soon be replaced by a more familiar native word already existing, which not only embodied the Dutch noun, but so accurately conveyed the insiduous and highly deceptive character both of the device employed and of the allurements by which its dupes were inveigled to their destruction.

The word "Decoy" seems to have been generally used by the early writers on the subject (Brereton, Evelyn and others, supposing their MSS. to have been correctly rendered, except

* The sources from which I have gleaned the above information are as follows:—Volume i. of the Chetham Society papers as already specified; Ormond's History of Cheshire, edit. 2 (1882), vol. iii. pp. 642, 3; and an Article on the History of "Old Cheshire Families" by Sir F. Dwarris, published in the thirty-third volume of 'Archæologia' (1849) pp. 55-83.

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where the Dutch name is avowedly quoted), and probably that was considered the correct English form; but doubtless the abbreviated form of "Coy," regardless of its being a return to the original Dutch, would commend itself to the vulgar. Even Fen-Bill Hall (in 1812) used the former word in his prose writings, having resource to the monosyllable only where the exigencies of the verse required it, as:—

> Born in a *coy*, and bred in a [water] mill,
> Taught water to grind, and ducks for to kill.

When the Decoy was first introduced into England it is difficult to determine with precision. The event has generally been attributed to Sir William Woodhouse,* who died in the year 1639, and probably Spelman's assertion† that he was the first to erect a decoy for taking wild fowl after the Dutch fashion, on the marshes at Waxham, was well founded, and we may take

* This Sir William Woodhouse of Waxham, knight, was not connected with the Wodehouses of Kimberley, one of whom bearing the same christian name, created a baronet in 1611, was contemporary with him. He was son and heir of Sir Henry Woodhouse who died in 1624 as shown in the pedigree given by Blomefield, not of Sir William as stated in the text; was knighted in 1591, and his will was proved in 1639. Spelman says of him, "Hic Gulielmus Woodhouse Eques Jacobo Regi nuper in facetiis, and Familiæ corruentis suscitator, primum apud nos instituit Decipulum Anatarium, peregrino nomine à Koye, i.e., *cors*, seu *cavea* nuncupatum." (Posthumus works, 1698 Edit. 'Icenia' p. 153). Apparently on the strength of this the author of the 'Norfolk Tour' makes him Court Jester to King James 1st, a construction which the above quotation certainly does not warrant. He was grandson of the Lord Keeper, Sir Nicholas Bacon, married a Jermyn of Rushbrook and was connected with the families of Heydon, Shelton and others of equal standing and therefore most unlikely to have been a professional Jester.

According to John Nicholas, F.S.A., author of the 'Progresses of King James 1st,' (Lond. 1828, 4 vols. quarto), he was with the King at Thetford in March, 1604-5, when his Majesty was "driven out of the [hunting] feeld with presse of company" and therefore went home and "played at cards." He was also one of the performers in Ben Jonson's "Masque of Hymen" produced at the Court on Twelfth-night 1605-6.

The real Court Jester to James 1st and Charles 1st was the celebrated Archie Armstrong, of whom and his fooleries several mentions are to be found in volumes ii. and iii. of the work just quoted.

† Posthumous works (Ed. 1698), 'Icenia' p. 153.

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it that this happened some years previous to his death; but Brereton, if he did not forestall Woodhouse, must have followed him very closely, for he evidently possessed a decoy in Cheshire, worked by a Dutchman, previous to his visit to Holland which took place in the year 1634. Evelyn mentions his visit to the King's decoy in St. James's Park on the 9th February, 1665; and on the 29th March following he says in his diary that "His Majesty was now finishing the Decoy in the park." * Willoughby (or Ray) in the 'Ornithologia' † does not mention the word decoy at all, but refers to the introduction of the system as something quite new at the time of his writing. After describing the old system of "driving" he thus proceeds:—"Our country men (imitating, as I suppose, the Low Dutch, who are authors of the invention) in maratime and fenny places, in pools prepared by a new artifice and fitted with their channels and nets, and stored well with Coy-Ducks" &c., he also adds that "some train a Whelp for this sort of fowling;" but his description of the process is imperfect, and the part he assigns to the dog, shows that he had not altogether divested himself of the old idea of "driving" the moulting fowl into tunnel nets which had so long been practised. The above was probably written by Willoughby, who died in the year 1672, so that it is evident the art of decoying was not very generally understood even at that time; indeed, so late as the year 1728, the pernicious system of driving evidently continued, notwithstanding that the Act of 9 of Anne (1710) C. cx., was still in force. I think it would be safe to infer that the Decoy proper, as we now understand it, was introduced into England from Holland quite as early as the second decade of the 17th century.

But it is quite time we accompanied Sir William in his journey to Holland. On the 22nd May, 1634, he and his party went on board "Mr. John Thompson's Pink" at Greenwich, a vessel of only fifty tons, filled up with merchandise and crowded with fifty-seven passengers, two of whom were women

* 'Evelyn's Memoirs,' 2nd Edit. (1819); 2 vols. 4to., vol. i. pp. 373 and 374. An account of the cost of building this decoy and of the materials used will be found in Cunningham's 'Handbook of London,' vol. ii., p. 434.

† 'Ornithologia' (Ed. 1678), p. 373.

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and four children. They put into Queenborough (Sheerness) where he slept at the "Ship" and bought "six lobsters for one shilling, one quick"; he never lost sight of his "hobby" and remarks that here was "a convenient place in the remotest part of the marsh for a Coy." On Friday, the 23rd May, they left Queenborough (he writes it Quindburrow) and reached Rotterdam on Sunday, after a twenty-five hours' passage. His chief object in visiting Holland seems to have been to examine and gain information as to the management of the decoys of that country, and although he gives some interesting particulars of his journey and of the places he visited, he never loses an opportunity of descanting upon his favourite theme. At Dort, on the 27th, he had "a coy-duck at supper, and another at dinner" and adds, "near unto the Doole build herons which breed in the middle of the City, which by proclamation are not to be molested or destroyed." Should these really have been Herons (which their nesting in company seems to confirm) and not Storks, their being protected is interesting; but, as will be seen later on, the same hospitality was extended to Spoonbills. His description of Dort and its decoys is as follows:—"Wednesday, May 28th, Dort. The island on which this fair maiden city stands, is compassed round by the Maze [Maas] and the Wall, two great navigable rivers. This island is about six or eight English miles about, and preserved by a strong bank about twelve yards high, beyond which bank are seated many (some say a dozen or twenty) coys. We were in three coys, all well wooded; two of them adjoining, close together, the one a lesser coy (which is the winter coy), hath five pipes, like unto mine; it is ten English rood long on the sides, eight rood broad; no wild fowl therein, but we were permitted to walk within the hut; the coy-ducks came boldly unto us and fed; belonging hereunto, one hundred and fifty ducks, thirteen drakes, dainty, fair specimens, and well-proportioned pipes, higher overhead, longer and better compassed than any I ever saw in England. Twiggen nests provided for the ducks to breed in. The other coy joining hereunto, much more spacious and larger; it hath six pipes in one end only, thirty-five rood long, and thirty broad. We were not permitted to see this larger coy. Ducks sold for sixpence a piece; two pellstarts, two smeathes, two shovelars, each equivalent to a Dutch

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[qy Duck] and four teal, sixpence. Another coy we saw, wherein are four pipes in one end; a great pool; the ducks fed with barley; the dog-farm, three rood from the hut or the pipes; and by the help of a little ladder, the dog is enabled to leap into the hole a yard high. The fowl in the little coy fed with barley. But we could not be admitted to take a full view of any of these coys, neither is there any spy-holes into the pond, but all their pipes are much more curious, and carry a far better proportion than ours." A foot-note by the Editor here rightly explains that the "pellstarts" mentioned above are pintails; "Pijlstaarts," Professor Newton tells me is even nowadays the common Dutch name for the pintail—pijl (pronounced pile) being a spike of any kind. Pijlstaart was the name applied by the Dutch sailors to the Tropic-bird from its long spike-like tail; staart is of course a tail, as in redstart, Start Point, &c. The Editor is in error however with regard to the "Smeath" which he takes to be the Smew (*Mergus albellus*) whereas it is an old name for the wigeon. The smaller ducks, pintails, wigeon, shovellers and teal were known to our decoymen and fowlers as "half-fowl" and counted twenty-four to the dozen.

On the 30th May at "Delft," the writer mentions that storks were kept tame, also shovellers, "birds with long legs, less bodies than our storks and broader bills; like our shovelars," the latter most likely being spoonbills. He also went to see a decoy near "Shippley," the owner being [acting as] his own decoyman. "His coy is situated near his own and divers other houses and the highways and navigable rivers on both sides, nearer by much than Doddleston Bridge or Findloes House is to my coy. His coy hath five pipes as mine, but better compassed, and two of them almost meet. Much wood, reed, grass and thicket within the hut, so as the fowl on one end cannot discern the dog showing elsewhere. . . . He hath about two hundred ducks, twenty drakes. He hath fowl bred twixt pellstarts and ducks, about twenty. I saw some of them. Many gray ducks which are best; coy-dogs best that are either white or red, and the more hairy the better. These ducks as tame and familiar about his house as any tame ones can be. Smeathes [wigeon] he keeps in a hut near his house covered with a net." I am not sure whether the "gray ducks" are gadwall, which are known by that

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name to our wild-fowlers, or whether it merely refers to the colour of the plumage, possibly the former. The inter-breeding of the pintail and the domestic duck although well known and not of rare occurrence is particularly interesting, for the early mention and the extent to which it was here carried.

On the 5th of June he was at the Hague, and "in the morning went to see some coys, whereof here are abundance. Six in my view: two whereof I saw, the former rented for two hundred and fifty gilders, the other for two hundred and twenty-five gilders a year. Six here are within half a Dutch mile. They had both three pipes in one end and one in the other; two hundred flying smeaths belong to one coy, abundance of pell-starts, and thirty pell-starts in one huck [hutch?] These coys near the highways, mighty high trees grow in both of them, so full of covert within the huck and without, as all ground, reed seatings and all, covered with wood. Here a coy-duck brings up chickens [ducklings?]; wood covered dome pipes so thick, as there is no net. Sometimes take two hundred in a day; sell them at Christmas for one shilling a duck; at other times sometimes sixpence, sevenpence, and eightpence, and ninepence, as in season. Trees herein as high as birches; their ducks, smeaths, and pell-starts exceeding tame."

The mode of travelling in Holland by land was by "waggon" or on the canals by "scute," and by the former conveyance he states that "upon Saturday, 7th of June, we went to John's fathers," the said John being his decoyman, a Dutchman whom he brought with him from England. "We went about six o'clock, and came to Allifein about half nine, which is nine English miles [from Leyden] . . . before ten hours we came to John's father, and went with him to his coy, wherein wood excellently grown. . . . The largest and neatest coy-house I have seen, lofted overhead to lay corn or hemp-seed, the pipes so straight, bending so little before you; four pipes only till last winter, two in either end: one more, added last winter of no use: here, by help of a windmill they can drown all the ground round about the coy." Then follows a description of the mill, the construction of which meets with Sir William's approval.

This is the last decoy they visited in Holland. His visit to

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the native home of his decoyman and in his company, seems to have given him great satisfaction; although he speaks of "John my coyman" he only casually mentions that his name was John Ward, probably the English form of Jan Waerd or some such name. The number of decoys in Holland at that time must have been very great, and the flights of fowl immense; it would appear as though they kept a stock of live fowl in huts covered with nets; but I do not understand the "two hundred flying smeaths" which he mentions as belonging to one of the decoys. Some of these decoys seem to have been very close to public highways, and indeed the absolute seclusion which has always been considered essential to the success of a decoy does not seem to be so needful, as was generally supposed. I know a decoy-pond in which the fowl can be seen on the water from the highway—accustomed sights and sounds are treated with indifference by the resting birds, but the crack of a whip or any strange or sudden noise rouses the sleepy fowl at once.

Brereton brought home to England a very large and miscellaneous assortment of goods, and among them a Dutch decoy dog for use in his own decoy.

The second journey was made in the next year, 1635. Sir William and his party left home on the 11th June, and after proceeding north into Scotland crossed over to Ireland returning on the 25th of July. He seems to have combined business with pleasure, more particularly in Ireland, and makes very shrewd remarks as to the value and capabilities of the land. He evidently owned property in Ireland as he mentions that in Dublin, on the 9th July, he lodged with his tenant, Ralph Brian and refers to some negotiations which evidently fell through. But he always had an eye to the suitability of the country through which he passed for the requirements of a decoy, nor did he ever, either at home or abroad, miss an opportunity of inspecting (when permitted) or of enquiring into the construction and mode of working of these institutions. As was usual in those days his party travelled on horseback, and when a sea passage was necessary it seems to have been very distasteful to him, as he was a bad sailor.

On June 23rd, Brereton stayed at the "Swan" at Newcastle,

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and remarks that his host, Mr. Swan, was a "very forward man to have a coy here erected." The next day on the way to Morpeth, "about seven miles from Newcastle," he says "we took notice of a convenient seat of a coy in Point island, which belongs unto Mr. Mark Arington."

We hear nothing more of decoys till the 17th July, when being at Wexford he was greatly impressed with the capabilities of the estuary of the river Slaney above Wexford harbour, and the broad-water lying to the north into which the little river Sow empties itself. About a mile from Wexford they crossed the water at a farm called "the park" leased by an Englishman named Hardye, there were "great loughs a mile or two broad" abounding with fish and fowl. "Here is the best feeding for fowl that I ever saw. This grass which comes from the mud is good food for them, and there is good store of it, and here is a little grove of oaks, wherein is no good timber, but it so stands as it is most strong shelter for fowl that feed or frequent under it. Here is the most commodious and convenient seat for a c[oy] that ever I saw." He adds that "Ollers" [Alders] and reeds and other materials necessary to form a coy may be had convenient; but there are certain difficulties with regard to position and planning which he considers at length.

The voyage home in a king's ship was a very unpleasant one and he suffered much from sea-sickness; but on the 27th July, on their return to England, journeying from Bridgwater, about four miles on his way to Rodney Stoke, he once more returns to his favourite subject. "About half a mile hence," he says, "is Orion's coy, which is placed very near a highway. This is a large, spacious coy pool, wood prospereth exceedingly well; by reason of the drought here was a great want of water until it was replenished and supplied with some late found out springs; earth is herein laid to the cherry-tree roots to keep them alive, and this seems but like mud. There are five pipes in this coy as in mine; the seatings within the coy are overgrown with wood; abundance here is of tame fowl; drake, pellstarts and smeaths I saw, but no ducks. The coy-house is larger than mine, both higher and larger."

"He advised me, if possible, to bring a spring into my coy, by the means hereof they took a good store of fowl last storm.

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I observed most part of the ground betwixt the pipes planted with withens [willows], except one orchard of cherry-trees. Here were three dogs of different colours, none so little, nor seeming so nimble as my coy-dogs. Here much oats is used as in my coy; very few ducks bred here this summer come to good." He went on to "Glassenburye" to the description of the Abbey, there he devotes some space, but says nothing about the decoy owned by the Abbey at Sharpham park.

All these particulars of decoys are of considerable interest, relating as they do to a method of taking fowl once so largely practised, but now, except in a few favoured localities, virtually abandoned in this country; and as some of the decoys referred to have not, I believe, hitherto been mentioned by writers on the subject, they seem worthy of recording in a county once the stronghold of these singular structures and in which the art of decoying still lingers.

III.

ON THE CAUSE OF THE THICK ADVENTITIOUS GROWTH ON THE BOUGHS AND TRUNKS OF OUR FOREST TREES, CHIEFLY THE OAKS AND ELMS.

By F. Long, L.R.C.P., President, N. & N. Nat. Soc.

Read 29th September, 1903.

My apology for bringing this paper before the Society on the night of its first meeting after the summer vacation is, that in another month or so the leaves will have been falling and the trees will only in imagination present the appearance that I am about to describe.

Any one going along the roads or walking through woods and plantations could hardly fail to be struck by the excessive amount

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of foliage on the Oaks and Elms; and yet if he were asked whether he noticed any difference in their appearance compared with eight or nine years ago, he would probably say that he saw no difference except that they looked very leafy, a condition that was probably due to the great amount of wet that we had had. The fact is, there is a vast difference, and what will be the effect in another eight or ten years fancy may easily depict. The change has come about so gradually that the majority of people have not noticed the steady growth of small branches on the trunks and boughs. I have taken great interest in the matter from the first and have watched very carefully each year the increase of growth. On looking up into an Oak one sees a whole forest of small branches on the upper side of the boughs. In the case of the Elms the growth almost encircles the boughs. For the true cause of this state of things we must go back to the spring of 1895. Most here will remember the very remarkable cold blast that swept over the country on the 15th May of that year, and I have thought it might be interesting to bring before the Society a note of the permanent effects, for good or for evil, which have been left behind on most of our forest trees as a consequence of that storm.

Mr. Arthur Preston has kindly furnished me with a few details of the weather about that period. On the 15th of May, a gale blew from the N.N.W., accompanied by sleet and hail. The maximum temperature was 44·2 degrees and the minimum 39·2 degrees. On the grass it fell to 37 degrees, and the following night to 33 degrees. This sudden change, as he says, was the more remarkable as it followed upon a previous very warm period, the thermometer having exceeded 70 degrees during the previous five days. In a day or so after the cold snap had passed the temperature quickly recovered again.

The Oaks and Elms previous to the cold snap had all burst into leaf, but whether the Ash had, I do not remember, probably not, as they are not affected, although I have seen a few about here in the same condition, notably some trees on the other side of Earlham bridge. The leaves being small and tender could not resist the icy blast, and the result was the complete destruction of all the foliage, so that in a few days the trees presented the appearance of winter again. It was not that the trees simply suffered on the side from which the blast blew but

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the whole tree was affected, and even the trees in woods were all blighted in the same way. In due time nature began to assert herself again and a fresh crop of leaves began to appear, whilst at the same time adventitious shoots started in great abundance all along the branches, giving them a fringed appearance. In many cases the whole trunk was encircled from the top to the bottom. This adventitious growth continued to increase and grow and is now merged into the general economy of the tree, and its branches at the present time extend from a foot to three or four feet. On looking at an Oak or Elm we no longer see the boughs in their simple nakedness with just a few normal branchlets, but instead, an adventitious growth almost encircling them, which in another eight or ten years will be so thick, that instead of a tree we shall be looking upon an enormous bush. Even now some of the smaller trees begin to present that appearance.

From information I received from Kew, the storm was general all over the British Isles, although the low temperature was confined to the northern and eastern parts of the kingdom. This agrees with what I noticed in travelling to Southport. From Nottingham on through Derbyshire to Manchester the Oaks were in their natural condition, or were but very little affected about the latter place. Further north, up to Windermere, I noticed that they were much the same as they are here.

The question now is, have the trees suffered in any way from this altered condition of their nature? From an æsthetic point of view, one would say that they had, for when the foliage has become so dense that the branches are no longer clearly visible, a good deal of their charm and beauty will be gone. From a commercial point of view one would say that the trees had suffered a good deal, the younger ones especially, although there has not been sufficient time yet to test it. All this extra growth must, I think, tend to arrest the full development of trunk for the purposes of timber. As a rule trees with a great number of small branches do not make fine timber. I am afraid not much can be done in the way of remedial measures as it would be impossible to strip all the trees, and even if this were undertaken in some cases, in a few years there would be the same condition again.

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IV.

A NEW STATION FOR *LIPARIS LŒSELII*, RICH. IN NORFOLK.

By Arthur Bennett, F.L.S.

Read 27th October, 1903.

In the 'Morning Herald' for August 29th, 1900, there appeared the following note:

"Rare Orchids in Norfolk.—A visitor to Norfolk (Mr. A. E. Buckhurst, M.A.) has found in a spongy bog near the east coast several specimens of the rare orchid *Liparis Læselii*, or two-leaved *Liparis*. Authorities state the plant is very rare, and is found only in Norfolk, Suffolk, and Cambridgeshire. As there is no Norfolk specimen in the Herbarium at Kew, Mr. Buckhurst has sent the plants there, and they are to be cultivated."

My attention was called to this at the time, but the finder wisely withheld the locality, and so one could not notice it. But last July Mr. Buckhurst wrote to me saying he had seen my Notes in the Society's Transactions,* and kindly gave the locality. It is one that takes it farther north in the county than any recorded habitat. He saw about thirty to forty specimens on a very boggy part of Honing Common, near the railway. In a later letter he mentions that he intended to visit the place again in August. This he did, and kindly sent me two small specimens (three inches high), but each had the flower stalk remaining of last year. It grew with *Drosera intermedia* (no *D. rotundifolia*), *Epipactis palustris* (very abundant), and *Parnassia palustris*.

This station is in a new watershed, *i.e.*, that of the Ant. It has now occurred in the Bure, Thurne, Ant and Waveney (Roydon) watersheds. The old station St. Faith's Newton, will, I suppose, also belong to the Bure.

It does not seem to have been recorded from the Yare or its tributaries.

* Trans. vol. vii. part iii. 1902, p. 333.

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Since the publication of my paper in 1902, three other stations have been ascertained.

In Hunts. Right side of Holme Lode. Rev. J. Roper in 'Fen and Mere,' p. 59 (1876).

Cambridge. "March Fen, Mrs. Elizabeth Reynolds' herbarium. In a letter from the Rev. Reader, Mr. Reader wrote to Mr. Jackson, of Leicester: "I think it probable that the *Liparis* was sent by Dr. Lloyd late in the 'thirties,' as she has (or had) *Rœmeria hybrida*, and other South Cambridgeshire plants from him, about that time."

On this my friend Mr. Fryer, of Chatteris, writes me: "The Firelots at Hook, near March, where Bog Myrtle still survives, and the *Lastrea Thelypteris*, is the only possible spot for *Liparis*, and that is impossible in this present century. Confusion! I did plant some bulbs by the one patch of Myrica Gale years ago. They disappeared. Did one or more hide themselves in that herbarium."

Mr. J. Britten, of the British Museum, sends the following extract from Sir J. E. Smith's Correspondence, vol. i. p. 275 (1821).

"You will be glad to hear that Crowe found three specimens of *Ophrys Lœselii* on St. Faith's bogs this summer; they were far distant from the spot in which Pitchford found his, and Crowe left them untouched; they were growing in the very wettest part of the bog, and actually in the water. Mr. Sole, of Bath, has found several on Hinton Moor, near Cambridge, where Ray mentions their growing. Roots have been sent to Curtis and to Dickson, and are growing in Curtis's and the Museum garden." T. J. Woodward. October 11th, 1787.

There is still another station (long since extinct) *i.e.* Reche Fen, in Cambridgeshire. "In plenty, June 15th, 1836." Babington. 'Journal of Life,' p. 49 (1897).

It is very pleasant to record new stations for a species that Babington in his 'Flora of Cambridgeshire' (1860) remarks on "in 1835 and 1836 for the last time," and in the Appendix puts it under 'Plants probably now extirpated.'

The fact is this species is like many other Orchids, subject to the same "ghost-like" appearance in abundance, and then scarcely to be found for many years. I had the pleasure of a visit from two

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American botanists, Dr. Kennedy and Mr. Fernald, of the Gray Herbarium, and I asked them if this had been noticed in America. They replied "No." Dr. Kennedy said he could vouch for the *Liparis* having appeared seven years in succession, and about as abundant each year at Willoughby, though both agreed that some of the North American Orchids were subject to this extraordinary disappearance for a time, and reappearance.

No reasonable explanation seems to have yet been given for it, though we have many theories. A suggestion is all I have to offer, and is this; it is what would be called a short-lived perennial, it is possible that the year it is so abundant it seeds freely, the plants die, the seed is floated about in winter until the water begins to run off the land in May, then the seeds settle down and grow. It is well known that Orchid seeds often take many years to come up, and before flowering.

The water level is high, perhaps, for some years, then comes a dry year (like 1883–4), and the plant is exposed to view. At Ranworth it certainly would not have been easy to get on the locality without water-boots in any ordinary year, but that year the spongy bog was much drier, though even then we did not dare to stand long in one place; one wants to live near the plant and study it year by year. An excellent account of its development will be found in Crepin's 'Notes plantes rare ou critique de la Belgique,' Fas. 5, p. 102 (1865); but it is too long to quote here. In 1848 Mr. G. S. Gibson and three others were unable to find *Liparis* on Burwell and Bottisham Fens, after several hours' search ('Phytologist,' 309 [1848]). This will serve to show how soon after drainage (about 1840) the plant disappears, yet in 1835 "The number of *Sturmia (Liparis) Lœselii* in Burwell Fen was enormous." Power to Babington, quoted in 'Journal of Life,' p. 40 (1897).

Liparis seems extinct in Huntingdonshire with the Great Copper Butterfly, but may still be found in Suffolk, Norfolk and Cambridge, but still should be gathered sparingly whenever found; many of our southern Orchids are becoming very rare, such as the Monkey, Military, and Lizard Orchids, and it is found absolutely necessary to keep their exact localities secret; it is strange that the last specimen of the Lizard Orchid gathered was found in a child's nosegay brought to a local flower show at Wye, in Kent.

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V.

A LIST OF ALIEN PLANTS FOUND GROWING AT OULTON BROAD AND LOWESTOFT SINCE 1897.

By Mr. W. A. Dutt.

(Communicated by the *Honorary Secretary*.)

Read 27th October, 1903.

Now that so much attention is being given at Kew Gardens and elsewhere to the alien plants which are so frequently unintentionally introduced into this country, and some of which have established themselves here, a list of a somewhat remarkable series of plants that have been found growing since 1897 in the neighbourhood of Oulton Broad and Lowestoft seems worthy of permanent preservation. For the drawing up of this list I am chiefly indebted to Mrs. Baker, of Oulton Broad, to whose careful researches we owe that these floral strangers in our midst were not allowed to bloom unrecognised. Nearly all of them were undoubtedly introduced into Oulton and Carlton Colville with cargoes of foreign seed, for they were found growing either on a small tract of sandy and gravelly waste ground adjoining the malthouse of Messrs. Morse at the east end of Oulton Broad or in loamy soil in the immediate neighbourhood of Messrs. Everitt's grain stores on the south side of the Broad. Messrs. Everitt's stores were destroyed by fire in the summer of 1900, and some of the plants germinated in the refuse of the destroyed buildings. A good many of the cargoes of seed that have been discharged at Oulton during the last eight years came from the Baltic, the Danube, South America, and elsewhere.

I have added to the list a few records of my own, most of them of plants which appear to have been introduced into Lowestoft with ships' ballast.

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Perhaps the most interesting record of all is that of MARRUBIUM ALYSSON, a rather attractive-looking, velvety-leaved, purple-flowered labiate plant. In a communication to the Rev. E. N. Bloomfield, Mr. S. T. Dunn, F.L.S., of Kew Gardens, states that this is the first British record of the species he has met with.

In identifying the plants, Mrs. Baker had the assistance of Mr. E. G. Baker, F.L.S., of the British Museum (Natural History), South Kensington, and I am glad to acknowledge my own indebtedness to him for having kindly revised a proof of the following list.

RANUNCULACEÆ.

ANEMONE RANUNCULOIDES, L. Oulton, 1898, W. A. D.
ADONIS AUTUMNALIS, L. Lowestoft, on ballast heap, 1899, W. A. D.
DELPHINIUM AJACIS, Reichb. Oulton, 1901, F. B.

PAPAVERACEÆ.

GLAUCIUM PHŒNICEUM, Crantz. Oulton, 1901, F. B.

CRUCIFERÆ.

MATTHIOLA BICORNIS, D. C. Oulton, F. B.
ALYSSUM INCANUM, L. Oulton, 1901, F. B.
,, HIRSUTUM, Bieb. Oulton, F. B.
,, MARITIMUM, L. Oulton, F. B.
SISYMBRIUM PANNONICUM, Jacq. Oulton, June and July, 1899, F. B.
,, ORIENTALE, L. Oulton, F. B.
,, COLUMNÆ, Jacq. Oulton, F. B.
ERYSIMUM ORIENTALE, R. Br. Oulton, 1899–1901, F. B.
,, REPANDUM, L. Oulton, F. B.
CAMELINA SATIVA, Crantz. Lowestoft, 1897, W. A. D.; Oulton, 1899–1901, F. B.
LEPIDIUM DRABA, L. Oulton, 1898–1899, F. B.
,, SATIVUM, L. Oulton, F. B.
,, PERFOLIATUM, L. Oulton, 1899, F. B.
IBERIS UMBELLATA, L. Oulton, 1900, F. B.

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MALCOLMIA AFRICANA, R. Br. Oulton, summer, 1900, F. B.
MYAGRUM PERFOLIATUM, L. Oulton, F. B.
ERUCA SATIVA, Miller. Oulton, F. B.
EUCLIDIUM SYRIACUM, R. Br. Oulton, F. B.

CARYOPHYLLEÆ.

SAPONARIA VACCARIA, L. Lowestoft, on ballast heap, 1899–1901, W. A. D. Oulton, plentiful, 1899–1901, F. B.
SILENE DICHOTOMA, Ehrh. Oulton, 1901, F. B.
„ CONOIDEA, L. Oulton, 1901, F. B.
GYPSOPHILA PORRIGENS, Boiss. Oulton, 1901, F. B.

LEGUMINOSÆ.

CORONILLA SCORPIOIDES (Koch.) Lowestoft, on ballast heap, 1899, W. A. D.; Oulton, 1900, F. B.
TRIGONELLA CÆRULEA, Ser. Oulton, June, 1899, F. B.
MEDICAGO APICULATA, Willd. Oulton, 1899, F. B.
„ LAPPACEA, Desr. Oulton, 1899, F. B.
MELILOTUS ARVENSIS, Wallr. Lowestoft, 1899, W. A. D.; Oulton, July, 1899, F. B.
TRIFOLIUM RESUPINATUM, L. Oulton, August, 1899, F. B.
„ STELLATUM, L. Oulton, 1900, F. B.
„ LAPPACEUM, L. Oulton, 1901, F. B.
VICIA VARIA, Host. Oulton, 1900, F. B.
„ NARBONENSIS, L. Oulton, 1901, F. B.
CICER ARIETINUM, L. Oulton, summer, 1901, F. B.

ROSACEÆ.

POTENTILLA NORVEGICA, L. Oulton, 1900, F. B.

UMBELLIFERÆ.

CARUM CARVI, L. Lowestoft, on rubbish heap, 1898, W. A. D.
SCANDIX AUSTRALIS, L. Oulton, 1901, F. B.
„ PINNATIFIDA, Vent. Oulton, 1901, F. B.
CORIANDRUM SATIVUM, L. Kirkley, 1898, W. A. D.; Oulton, June, 1898, F. B.
CAUCALIS LATIFOLIA, L. Oulton, July, 1899, F. B.
„ LEPTOPHYLLA, L. Oulton, 1901, F. B.

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RUBIACEÆ.

ASPERULA ARVENSIS, L. Lowestoft, on ballast heap, 1899–1901, W. A. D.; Oulton, 1899, F. B.

DIPSACEÆ.

CEPHALARIA SYRIACA, Schrad. Oulton, 1901, F. B.

COMPOSITÆ.

ERIGERON CANADENSE, L. Kirkley, 1897, W. A. D.; Oulton, well-established. F. B.

ANTHEMIS TINCTORIA, L. Lowestoft, 1897, W. A. D.; Oulton, 1899, F. B.

,, MIXTA, L. Oulton, 1901, F. B.

CHRYSANTHEMUM CORONARIUM, D. C. Oulton, 1901, F. B.

CNICUS ARVENSIS var. SETOSUS, Bess. Carlton Colville, 1898–1899, F. B.

CENTAUREA DEPRESSA, Bieb. Oulton, 1901, F. B.

PYRETHRUM DECIPIENS, F. & M. Oulton, 1901, F. B.

AMBROSIA TRIFIDA, L. Oulton, 1901, F. B.

,, MARITIMA, L. Oulton, 1901, F. B.

CAMPANULACEÆ.

SPECULARIA SPECULUM, D. C. Oulton, 1900, F. B.

POLEMONIACEÆ.

GILIA CAPITATA, Sims. Oulton, 1901, F. B.

BORAGINEÆ.

ASPERUGO PROCUMBENS, L. Lowestoft, on ballast heap, 1899, W. A. D.; Oulton, 1899–1901, F. B.

ANCHUSA OFFICINALIS, L. Oulton, 1900–1901, F. B.

ECHINOSPERMUM LAPPULA, Lehm. Oulton, 1901, F. B.

AMSINCKIA LYCOPSIOIDES, Lehm. Oulton, 1901, F. B.

CONVOLVULACEÆ.

CUSCUTA TRIFOLII, Bab. Lowestoft. 1901, W. A. D.

SCROPHULARINÆ.

VERONICA CHAMÆPITYS, Grisebach. Oulton, 1901, F. B.

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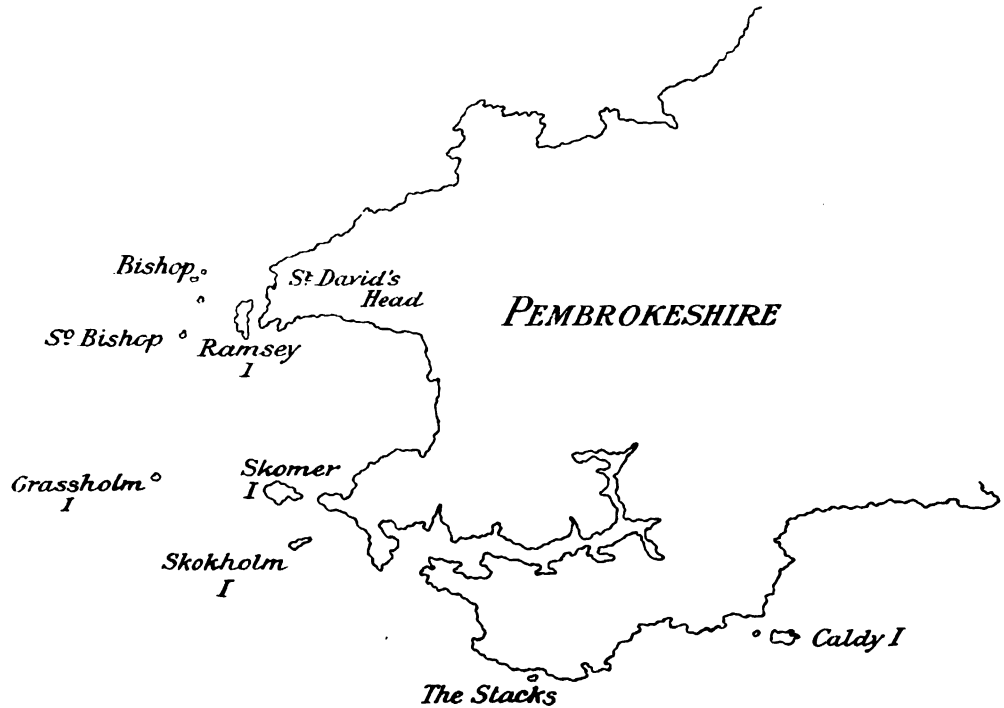

SKETCH MAP OF PEMBROKESHIRE COAST.

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LABIATÆ.

CALAMINTHA GRAVEOLENS, Bth. Oulton, 1901, F. B.
MARRUBIUM ALYSSON, L. Oulton, June, 1899, F. B.
STACHYS ANNUA, L. Oulton, 1901, F. B.
SIDERITIS MONTANA, L. Oulton, 1901, F. B.

PLANTAGINEÆ.

PLANTAGO LAGOPUS, L. Oulton, 1899, F. B.
„ ARENARIA, Waldst & Kit. Oulton, in several places, 1899, F. B.; Lowestoft, 1899–1903, W. A. D.

AMARANTHACEÆ.

AMARANTHUS RETROFLEXUS, L. Oulton, 1901, F. M.

GRAMINEÆ.

PHALARIS CANARIENSIS, L. Lowestoft, 1897–1903, W. A. D.; Oulton, 1898–1899, F. B.
„ PARADOXA, L. Oulton, 1898–1899, F. B.; Lowestoft, 1899, W. A. D.
LAGURUS OVATUS, L. Oulton, June, 1899, W. A. D.
CYNOSURUS ECHINATUS, L. Oulton, 1901, F. B.
ECHINARIA CAPITATA, Desf. Oulton, 1901, F. B.

VI.

ON THE BIRDS OF THE PEMBROKESHIRE ISLANDS.

BY J. H. GURNEY, F.Z.S.

Read 24th November, 1903.

FEW people possibly are aware what romantic islands there are lying off the coast of Pembrokeshire, or how attractive to the zoologist or botanist. The principal of these islands are Skomer, Ramsey, Grassholm, Caldy and the Eligoog (Guillemot) Stacks; but there are any number of smaller rocks, and birds of some sort breed on many of them.

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With three friends I was able to land on the two first named islands, and sail round the third, at the end of June (June 26—July 3) 1903, and a memorable opportunity it was. The map will show, better than any explanation, the position of the islands, and also the bold promontory known as St. David's Head, where the Grey Seal may be seen playing beneath the cliffs, and Buzzards and Kestrels breed and a Rock Dove or two, and hard by the Grasshopper Warbler was still in full song.

On none of these Welsh islands are Razorbills nearly so plentiful as Puffins and Guillemots. It is the same at every breeding station round the British Isles, and there can be no doubt that not only with us, but throughout the whole of Europe, the Razorbill is numerically less abundant than the Guillemot. Dr. Bryant says the same of it at the stations in the Gulf of St. Lawrence, N.A.

Choughs seem to have become very scarce in Wales, and we thought ourselves lucky in meeting with one family party of seven on Ramsey island. Their curved beaks serve to distinguish them from the Jackdaw, as well as their longer wings at some distance. A pair or two may still frequent St. David's Head, but the Jackdaws have supplanted them and taken many of their nesting places, they being the stronger species. Something is no doubt also due to the rapacity of certain egg dealers; but if the Jackdaws could be killed down, the Choughs would increase again, for there can hardly be any doubt that it is by them they have been driven out. I tried to gather some traditions of their having formerly inhabited the ruins of the Bishop's Palace at St. David's; but if they ever did so, it must have been very long ago.

Skomer Island.

Skomer, derived from a Danish word meaning rocky, an epithet it well deserves, is an island of some 700 acres on the south of St. Bride's bay, the property of Lord Kensington, who has a keeper upon it employed in breeding chickens, and to whose agent, Mr. Fergusson, application should be made for permission to land. An account of its geology is given in the Transactions of the Cardiff Naturalists' Society (vol. xxviii. p. 55, xxix. p. 62), and it appears to be of considerable interest from this point of view; but

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SKOMER ISLAND, PEMBROKESHIRE.

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our object was the birds, and we had no time to examine into its strata.

The Puffins are the great sight on Skomer, and, indeed, their numbers and quaintness and the military uprightness with which they sit, or rather stand in rows, is extraordinary. Puffins are more numerous here than in any other Welsh island, and as numerous as at the Saltees on the coast of Wexford. It will be within the mark to say there are 7,000 Puffins on Skomer island, and 3,000 more on Grassholm; but any attempt at counting is futile, neither could it be done by counting the holes with which Skomer is riddled because a good many are tenanted by Shearwaters and Rabbits.

A portion of Skomer island is covered with bracken, but it is in the bare places carpeted with turf and the Sea Pink that most of the birds' holes are, and here the keeper's dog proved very useful in sniffing them out. In these places a good deal of fighting goes on under ground, and strange growlings may be heard proceeding from the interior of their burrows, which are so near the surface that the foot involuntarily slips through the crust into them.

The Puffin's powerful bill must always make him master, and accordingly the keeper accuses Puffins of dispossessing Rabbits of their holes, and even of killing many young ones, but I think he exonerates the more peaceful Shearwaters. As for the Shearwaters they might as well not be on Skomer at all, for all a visitor knows of them in daytime, though, as a matter of fact, there lie asleep beneath him many hundreds of these birds. A good many Skomer Shearwaters on first arrival are unintentionally caught in rabbit traps, and I am afraid the keeper is more annoyed by the springing of his traps than by the destruction of the birds, as the Rabbits represent money and the Shearwaters do not.

A good account of Skomer, from a Naturalist's point of view, is that contributed some years ago to 'The Zoologist' (1884 p. 433) by the Rev. M. A. Mathew, who spent a night on the island with Mr. Propert, of St. David's, in order to hear the nocturnal wailing of the Shearwaters. Another narrative of a visit to the island is from the pen of Mr. Drane in the Transactions of the Cardiff Naturalists' Society, 1895-6, p. 61. Mr. Drane found some crania on the island which he considered were the skulls of the Greater

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Shearwater, it is possible therefore that this species may breed there,* on which point farther evidence is desirable.

The Rev. M. A. Mathew considers Skomer island to be the metropolis of *Puffinus anglorum*. In our short visit we had no means of judging of their numbers, for very few were seen at sea, and beyond disinterring a few with our hands, which could just be reached by a long arm, we did not molest them. They seemed very sleepy when thrown up, generally falling again at no great distance, though this is not from inability, for at night they fly as much over the island as over the sea, and the keeper and his wife find their incessant wailing very wearisome, as they pass and repass his cottage, which is the only house on the island.

In one burrow a Shearwater and a Puffin were discovered in the same hole, and an egg with them, while in another burrow was a nestling Shearwater with its parent; the former clad in a grey blanket of thickest down, feet and legs the same colour; the legs already showing the curious pied appearance, so remarkable in the adult. Manx Shearwater's eggs are for the most part white; but Puffin's eggs get very quickly soiled, though white when laid. Their burrows seldom go straight, those of both species generally having one turn in them at least; but the Puffin's egg is not so far from the entrance as the Shearwater's generally is, this latter being seldom less than three feet, so that a spade is requisite to obtain them. No Shearwaters were seen to leave their holes voluntarily.

As for the keeper's chickens which he rears there in some quantity, they are not likely to be successful while Peregrine Falcons breed on Skomer, and I fear he will soon devise means to compass their death. He had already had eighty (!) chickens killed by them, besides which the Jackdaws are a dire foe, having cleared off forty-six small ones in one morning from three coops; but the Jackdaws persecute the Choughs, and for that reason, if for no other, could be spared. But one sighs to think of the fate of the noble Peregrine.

Ramsey Island.

Ramsey is the most beautiful island of Pembrokeshire, 800

* Its presence in considerable numbers on the West Coast of Scotland in summer has been dwelt upon by Professor Newton (Ann. Scot. N.H., 1900, p. 142).

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acres in extent, separated from St. David's Head by a channel two miles in width, through which even in calm weather there runs a tremendous tide. It abounds with Rock Birds on its seaward side only, where every little bay has also its Grey Seal or two.

In Bishop Gibson's edition of Camden's 'Britannia' (ed. 1772) there is an account of Ramsey, with some notice of its birds by the Rev. Nicholas Roberts, and especially of four kinds which bred there and on some adjoining islands (probably the North and South Bishop Rocks and 'The Clerks'). The four species are:—

The Mora (Guillemot).
The Poethwy (Razorbill).
The Pâl (Puffin).
The Harry-bird (Manx Shearwater).

Shearwaters probably still breed on Ramsey in very small numbers, for my son picked up the remains of a dead one, and of the other three species there are plenty.

The numerical strength of the birds breeding on Ramsey island may be roughly reckoned as follows:—

Guillemot ...	4,000	
Bridled ...	16?	
Razorbill ...	800	
Puffin ...	150	
Shag	50	
Cormorant? ...	0	(I did not see any, but Mr. Mathew says Cormorants are in equal numbers with Shags).
Kittiwake ...	400	
Herring Gull ...	200	
Oyster-catcher ...	70	
Peregrine Falcon	2	
Buzzard ...	2	(No nest in 1903)
Raven ...	2	
Chough ...	4	
Jackdaw ...	500	
Carrion Crow ...	4?	(Perhaps not breeding).
Rock Dove ...	8?	
Stock Dove ...	12	

It is difficult to calculate any feathered population, but in the case of these Guillemots I was determined to arrive at a census of

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some kind, and considered that something might be done by reckoning the birds according to their ledges. After two days on the island, I should guess that there might be, all told 250 Guillemot occupied ledges on the island, tenanted say as follows:—

2	ledges of	fifty	Guillemots	= 100
8	,,	forty	,,	= 320
16	,,	thirty	,,	= 480
40	,,	twenty	,,	= 800
90	,,	ten	,,	= 900
50	,,	five	,,	= 250
50	,,	three	,,	= 150
150	,,	two	,,	= 300

3,300 Guillemots.

Add to 3,300, three hundred more for single Guillemots scattered about, and we get a total of 3,600. Some 400 Guillemots would probably also be on the wing or on the water, but near enough to be within sight, but all these belong to the ledges and have been reckoned as if they were on them. Probably again 400 more belonging to this settlement would be fishing in St. Bride's Bay, or still further away, which would make, supposing they were all at home together, an assembled commonwealth of 4,000 Guillemots.

There is no restriction as to taking eggs on Ramsey beyond the difficulty of getting them, and a good many are annually used for clarifying wine, feeding poultry, pigs, etc., and a few are eaten by the poorer inhabitants, but the yelk is coarse. We were told that about 1,000 had been recently taken and brought into St. David's for the wine trade, all probably from this island. They seemed to be very richly coloured, and one was so abnormally small as to be only one third its proper size; but we did not see this *in situ*, though my son obtained it in the yelk.

Another thing we had come to observe was the direction in which these sea-birds face when on their ledges; but this proved not so easy as I had anticipated. However, more often than not, Guillemots and Razorbills when incubating, sit face to cliff, *i.e.*, with their backs to the sea. Certainly they prefer as a rule at Ramsey to have the wind at their backs; but even to this there are

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exceptions, this much may be said, what one Guillemot on a ledge does the others generally do.

The Welsh name of the Guillemot is "Eligoog," and is a name of very old standing. John Ray, who visited St. David's in June, 1662, with Willughby, spells it "Elegug" ('Memorials of John Ray,' edited by E. Lankester, p. 176), but in their well known 'Ornithologia' (1676), p. 325, they spell it "Helegug": it is still commonly used. "Heli" Mr. Thomas tells us means "salt water, but I can find no word in the Welsh dictionary corresponding to "goog."

Grassholm.

Grassholm,* *i.e*, green island, is of a more or less conical shape but not very lofty, uninhabited, and there are no trees of any kind In spite of its exposed position its slopes are covered with grass which is burrowed into by many hundreds of Puffins, particularly on the south side; and quantities of these birds swam in the water as we sailed twice round the island, but not a single Gannet was to be seen swimming. On the north and east, Grassholm is precipitous, and here it is that the top of the cliff, which in one place forms a table, is occupied by the largest company of Gannets all close together as if room on their select spot was valuable, but not in rows. A good many Kittiwake Gulls occupy the lower places on the cliffs, and add to its beauty by their graceful forms and silent flight.

Further on, are five smaller companies of Gannets, also on or near the top of the cliff, numbering say forty Gannets a-piece on an average, as well as three or four yet smaller parties of eight or ten. The large company first mentioned may well number 100 Gannets or more, and, allowing about ten for single birds, we thus have a total of 340; but probably it is fair to reckon that 160 were at sea, though we did not see above sixty, if as many, on the wing in the vicinity of Grassholm. If we assess the total settlement at 500 adult Gannets, that is making a liberal allowance, and is the same estimate arrived at in 1886 by Mr. M. D. Propert whose acquaintance I had the pleasure of making at St. David's. In 1893, Mr. Drane considered there were 240 nests (*l.c.*). In 1895, Mr. Jeffreys, of Tetbury, who landed on the rock, informs me that

* Leland, the antiquary, spells it Gresse Holme, 'Itinerary,' vol. xxvii.

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there were fully 300 nests, which was more than when he was there in 1893.

Five or six piebald Gannets, handsome fellows in the second year's plumage, were flying near the rock, but there were no black ones, and I was much surprised at seeing the piebald birds, as they have been said never to frequent breeding stations. At the instigation of Professor Newton I made many enquiries as to the age of this settlement, but without much definite result. Many of the fishermen could remember them for twenty years or so, and one named John Watts could speak to their having been on Grassholm rock over forty years, while one of the oldest inhabitants, Mr. Williams, of St. David's, remembered that his father-in-law, Henry Bowen, assured him there were Gannets there as far back as 1820, but not many of them.* Since then they appear to have been on different occasions somewhat persecuted, so that at one time the settlement was very low, but in spite of all vicissitudes never entirely deserted.

A good account of Grassholm island by Mr. R. Drane is to be found in the Transactions of the Cardiff Naturalist's Society, 1893-4 (vol. xxvi. p. 1), but I think his estimate of the large Puffin settlement is much too high. It is twelve miles from St. David's, but is better reached from Milford: there is only one landing place, which is on the south side. Mr. Drane remarks from observation that two Gannets, presumably its father and mother, will feed the same young Gannet alternately.

The North Bishop.

'The Bishop' and a cluster of smaller rocks known as 'The Clerks lie about two miles west of Ramsey, but we did not go near enough to them to see the birds, which I was informed breed there, including a pair of Peregrine Falcons, whose eggs had been recently taken for some collector. This species is unfortunately a good deal persecuted, and is not nearly so common as it might be,—the pair at Ramsey had recently lost their eggs. Pembrokeshire Falcons had a reputation in the time of Henry II., who sent thither every year for eyesses (the nestlings), *see* 'The Worthies of England' *endeavoured* by Thomas Fuller, D.D., M.DC.LXII.

* It was most likely from Grassholm that a Gannet's egg in Prof. Newton's collection, presented to him by the late Mr. A. F. Sealy, inscribed "South Wales, Stack Rock" came, and this egg, Prof. Newton tells me, was taken prior to 1864.

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VII.

ENTOMOLOGICAL NOTES FOR 1903.

By W. H. Tuck, M.A.

Read 24th November, 1903.

Since sending my last notes, I have left Tostock and moved to Bury St. Edmunds, and, although only six miles away, I soon found several new things in every order. Starting with Aculeate Hymenoptera, I took in the garden, upon the outskirts of the town, a new Bee to my list Halictus smeathmannellus, two queens and two males in July. This Bee breeds in old walls and is apparently a town species. I also took about the same time both sexes of a rare little Bee, Prosopis pictipes. I had only taken it once before, in 1892, at Tostock—both these were upon that useful plant *Doronicum pardalianches*—one of the best of our English *Compositæ*. In Fossores, the following new things have occurred on Wild Carrot, Gorytes tumidus, August 19th; several:—Spilomena troglodytes—same date; Nysson dimidiatus, July 5th. The fine large Ichneumon, Rhyssa persuasoria, occurred twice this season, once in the town of Bury, and again in Rushbrooke Park; it is parasitic upon the big Saw Fly, Sirex gigas; these were unusually abundant this year. The only Dipteron I had worth recording was the handsome Merodon equestris: the larva of this fly is said to feed on the Wild Carrot root.

Bury is a fine centre for the Water Coleoptera; the rivers Lark and Linnet with their tributaries flow through the town, while within easy distance are the Canal, Blackwater and Thet. Early in June, from a small mere opening out of these rivers, I took a fine series of a Haliplus, which Mr. E. A. Newbury thinks will prove a new species; it appears to be intermediate between

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H. fluviatilis and H. ruficollis, but it takes time to be confirmed by the European coleopterists. In the Bury streams Dytiscus punctulatus occurs sparingly, as also does Hydroporus halensis: Deronectes depressus is frequent when the rivers are in flood.

At Bungay, in August, I took a fine series of Cœlambus versicolor which also occurs in the canal here. In the Waveney I also took Agathidium marginatum in flood refuse, and also Hydræna testacea. Early in April, I found in a cellar in company with a large quantity of Blaps similis and B. mucronata, a fine specimen of Blaps gigas (gages). Mr. E. A. Butler, to whom I sent it, thinks it must have been bred in Britain, to which it is practically a new addition. The following are new to Mr. Morley's Suffolk list—Homalota mortuorum, Corticaria similata, Cyphon coarctatus—while among other notable captures were Philonthus ebeninus in a dead bird, Melœ violaceus upon a garden flower, and the rare timber borer, Hylastes cunicularius—upon Wild Parsley at Hardwick.

In Hemiptera, the best things I had were Verlusia rhombea, new to the county list, as is Atractotomus magnicornis which I beat from Fir in a Bungay garden. Altogether, I consider it was a good season for insects, although the weather at times was disappointing.

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VIII.

THE FRESH- AND BRACKISH-WATER CRUSTACEA OF EAST NORFOLK.*

By Robert Gurney, B.A.

Read 26th January, 1904.

Excluding scattered references in works on British Entomostraca, but little has hitherto been published on the Crustacea of Norfolk. The only satisfactory list is that of Mr. Scourfield, published this year, but even that is not complete, and also it gives no information as to localities. In the present paper, I intend to give a list of all the fresh- and brackish-water species hitherto recorded, except the Ostracoda; being myself responsible for practically all the records. The Ostracoda have been omitted for various reasons, one of which is that a fairly complete list of them may be found in a paper by Messrs. Brady and Robertson (1870).

The Broads District may be included in a triangle "having for its angles Norwich, Lowestoft and Happisburgh" (Lubbock, 1879, p. 79), and I believe I have obtained a tolerably accurate knowledge of the Crustacean fauna of this district. Fritton Lake and Oulton Broad cannot fairly be excluded from a survey of the Broads District.

I have naturally devoted myself more particularly to the Broads themselves, and I think that my list of species, for them and for the rivers with which they are for the most part connected, is sufficiently complete. The attention paid to the different Broads has, however, been very unequal, Sutton Broad having, of course, been worked far more thoroughly than any other. In fact, if I had no further records than those from Sutton and its neighbourhood, my list, of Cladocera, at any rate, would not be very materially curtailed. This district is no doubt actually richer than any other, but probably many additions remain to be made to the lists

* This paper is the result of work carried out at the Sutton Broad Laboratory during the year 1903, and any dates given refer to that year.

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for the other Broads, and particularly for the ditches connected with them.

For the purposes of this investigation my wherry, the "Cyclops," has proved invaluable, since by her means the ground has been covered far more thoroughly and easily than would otherwise have been possible. A wherry is better adapted than any other boat for such work, since she not only provides ample room for carrying the necessary apparatus, but also allows a considerable amount of microscopic work to be done on board in comparative comfort. I have also made extensive collections in ponds and ditches in the district, and have been very much assisted in this direction by Mr. R. A. Todd, who has sent me numerous collections from various parts of the county, and has in this way supplied me with many very valuable records.

As is well known, the Rivers and Broads of Norfolk are the last relics of the great estuaries which at one time penetrated far into the county. At the present day such estuarine conditions are only preserved in Breydon Water, but even now the salt water reaches some way up the rivers, and there is a tidal rise and fall extending in the Yare, for instance, as far as Norwich. Accurate information as to the tidal rise and fall at different points, and as to the distance up the rivers at which salt water can normally be detected, is not forthcoming at present, though hearsay evidence can be collected in abundance. Unfortunately, the Norfolk waterman often uses the term tide indifferently for an influx of salt water, a periodic (tidal) banking up of fresh water, and for the irregular rise and fall of water due primarily to rain, so that his evidence is not reliable. For the Bure, at all events, it can be stated that the salt water does not normally reach higher than Acle Bridge; but that during periods of exceptionally high tides, sometimes due to a prevalence of strong Northerly winds banking up the water in the North Sea, the salt water may reach right up to Ant mouth, and from there up the Ant even to Irstead. On such an occasion I have even taken marine Calanoids and living Ctenophores at Thurne mouth. It follows that the inhabitants of the rivers and some of the Broads must be exposed to fluctations of salinity of considerable, and sometimes of very great magnitude. At every tide there must be a great destruction of the floating forms in the lower reaches of the rivers, and in fact

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such a destruction can be shown to occur; but I believe that many of the more sedentary species have acquired the power of resisting such ranges of salinity that they are enabled to live permanently in the intermediate zones, though properly belonging either to fresh or to salt water. It is quite probable that differences in adaptibility could be shown to exist between groups of individuals of the same species taken from different localities.

In consequence of the tidal nature of the rivers, the true fresh-water fauna is invaded by a number of species which belong properly to brackish-water or are even typically marine. Some of these species have established themselves beyond the limits of even abnormal tidal influence. It has therefore been found necessary to include these brackish-water forms in my list, and in fact it is very difficult to know how or where to draw the line. I have thought it best to include in my list all those species which I have found associating with true fresh-water forms, since obviously any geographical boundary is out of the question. For instance, at the Yacht Quay in the North River at Yarmouth a tow net collection may at times be made up entirely of quite characteristic fresh-water forms; at other times the species may be entirely marine; and at others again partly marine and partly fresh-water. So much depends upon the state of the tides and river currents. I have, however, not always followed even the above rule, for had I done so, I should have been forced to include many chance marine immigrants such as *Acartia discaudata* or *Carcinus maenas*. Those that have been included are generally such species as I consider may habitually occur in the conditions in which they have been found.

But, apart from the tidal nature of the rivers, and the consequent introduction into the Norfolk fauna of semi-marine species, the physical conditions obtaining in the Broads in general are somewhat peculiar owing to their proximity to the sea. The salinity of the water is always a little above the normal of pure fresh water, probably owing to salt spray blown in from the sea. This relatively high salinity can hardly be without influence upon the presence and distribution of certain species.

In the list that follows, where no mention of localities is made, it must be understood that the species in question is widely distributed, and further information must be sought in the table of distribution given at the end.

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As regards the nomenclature used; I have followed, for the Cladocera, Lilljeborg's "Cladocera Sueciæ." For the Copepoda I have used the nomenclature of Schmeil (Deutschlands freilebende Süsswasser-Copepoden) with certain alterations made necessary by the papers of Lilljeborg (1901 and 1902) and Scott (1903).

CLADOCERA

Sididæ.

Sida crystallina (O. F. Muller). Occurring commonly in all the fresh-water Broads with one or two exceptions. Not in the Hickling region.

Diaphanosoma brachyurum (Lievin). Distribution much as fo the preceding species.

Daphnidæ.

Daphnia magna, Straus. Common throughout the district in farm ponds, but rather capricious in its occurrence. Apparently in other parts of England it is rare.

, Atkinsoni, Baird. This species has hitherto been found only near Staithes in Yorkshire. On June 16th of last year, Mr. R. A. Todd found it abundant in ponds near Happisburgh, and I have myself found it since then both in the same ponds, and in ponds at Honing and Brumstead.

,, pulex (De Geer). I have not separately recorded the different varieties of this species, but *D. hamata*, Brady, and *D. obtusa*, Kurz certainly occur frequently. The latter is the most distinct of these varieties, but I have found males agreeing in all respects with those of *D. obtusa* associated with females of the typical *D. pulex*.

,, longispina, O. F. Muller. Abundant in clear water all over the district, but only exceptionally found in large open waters, where its place is taken by the pelagic species *D. cucullata* and *D. lacustris*. In fact, it seems likely that the latter is only a strongly marked variety of *D. longispina* adapted to a pelagic existence.

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DAPHNIA LACUSTRIS, Leydig. South Walsham, Ormesby and Rollesby Broads, and Fritton Lake. A single record from Barton Broad.

,, CUCULLATA, Sars. Abundant in all the open Broads except the Hickling group, and taken occasionally at Sutton and Barton. It does not seem to occur at all in the Yare or its Broads.

SCAPHOLEBERIS MUCRONATA, O. F. Muller. The typical form of this species is very rare, and only occurs late in the year.

,, AURITA (S. Fischer). This is a new record for the British Isles, for which I am in the first instance indebted to Mr. R. A. Todd, who found it in a pond at Herringfleet. Curiously enough both he and I, myself, had collected in this same pond before without discovering it, and it practically disappeared very shortly after. Such cases of sudden appearance and disappearance of conspicuous species may perhaps be explained, as has been suggested by Mr. Scourfield, by the assumption that the species has been introduced by birds, but has found the conditions unsuitable for a permanent home. I have since found *S. aurita* in a ditch at South Walsham, and also in Catfield Fen. Like the preceding species it has the habit of swimming on its back supported by the surface film, but this suspension seems to be effected by means of a series of minute teeth disposed along the flattened ventral margin of the shell valves, and not by modified setæ as in *S. mucronata*.

SIMOCEPHALUS VETULUS (O. F. Muller).

,, EXSPINOSUS (Koch). Somerleyton, Smallburgh, Blundeston, and Sutton. A rare species, found only, in my experience, in ponds and small ditches.

CERIODAPHNIA RETICULATA (Jurine). Generally in small waters only. The variety *serrata*, Sars, occurs fairly frequently.

,, MEGALOPS, Sars.

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CERIODAPHNIA QUADRANGULA (O. F. Muller). Widely distributed, but nowhere common. The variety *S. hamata*, Sars, seems to be of more frequent occurrence than the type form.

,, PULCHELLA, Sars.

,, AFFINIS, Lilljeborg. This is the rarest species of the genus. Recorded from Sutton, Martham, Barton Broads, Candle Dike, Buckenham, and a ditch at Ludham Bridge.

,, LATICAUDATA, P. E. Muller. Rare; generally in small waters, but sometimes also in the open Broad, as, for instance, at Hickling.

MOINA RECTIROSTRIS (Leydig). The only localities known to me at present are ponds at Thorpe, Herringfleet and Hopton.

BOSMINIDÆ.

BOSMINA LONGIROSTRIS (O. F. Muller).

LYNCODAPHNIDÆ.

ILYOCRYPTUS SORDIDUS (Liévin). Curiously enough, this species is capable of withstanding a very high salinity; for it lives in Heigham Sounds, and has been found nowhere more common than in a creek running off from Oulton Broad.

,, AGILIS, Kurz. Barton, Sutton, Ranworth, Wroxham and Rollesby Broads.

,, ACUTIFRONS, Sars. Only recently added to the British list, having been discovered by Mr. James Murray in Sutherland. In Norfolk it occurs in Wroxham Broad, and I have also found it at Sutton.

MACROTHRIX LATICORNIS (Jurine). Only recorded at present from a pond at Thorpe and in the Waxham Cut at Lound Bridge.

LATHONURA RECTIROSTRIS (O. F. Muller). A common species at Sutton and Catfield Fen, but otherwise rather rare. Other localities are: Barton, Calthorpe and Irstead.

LYNCEIDÆ.

EURYCERCUS LAMELLATUS (O. F. Muller).

CAMPTOCERCUS RECTIROSTRIS, Schoedler. Sutton, Barton, Rollesby, Ranworth and Wroxham. A decidedly rare species.

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CAMPTOCERCUS LILLJEBORGII, Schoedler. Only quite recently added to the British list, being taken by Mr. Scourfield in the Ant near Sutton Broad in 1898. It is fairly common in Catfield Fen, where *C. rectirostris* does not occur, and has been found several times at Sutton.

ACROPERUS HARPÆ, Baird. Common almost everywhere, and exceedingly variable.

,, ANGUSTATUS, Sars. The first British specimens of this species were taken by Mr. Scourfield in the Ant, and he has since shown me one taken in Sutton Broad. In all the hundreds of specimens of Acroperus which I have examined during the past year, I have seen none that were not referable to *A. harpæ*, for I believe that all intermediate variations occur between the two species. Another point which seems to me to be of great importance is this: though, during October and November, ephippial females of *A. harpæ* are quite common, I have never seen a male at all answering to the descriptions given by Lilljeborg for that species. On the other hand, males exactly agreeing with that of *A. angustatus* are always to be found in company with the ephippial females of *A. harpæ*. I believe, myself, that *A. angustatus* and *A. harpæ* are extreme forms of one and the same species.

LYNCEUS QUADRANGULARIS (O. F. Muller). This species, which very closely resembles *L. affinis*, is much more constantly confined to muddy bottoms than the latter.

,, AFFINIS, Leydig.

,, TENUICAUDIS (Sars). Very rare. Hickling, Sutton, Catfield Fen and ponds at Brumstead and Herringfleet.

,, COSTATUS (Sars).

,, GUTTATUS (Sars).

,, RECTANGULUS (Sars). Common, especially in soft yellow mud, rich in Marsh Gas. This mud, which is of a quite characteristic appearance, is the favourite haunt of several of the rarer bottom forms, such as *Leydigia* and *Ilyocryptus*.

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LYNCEUS ELEGANS (Kurz). The only previous record of this species is from a pond in Yorkshire. It has been well figured by Mr. Scourfield (1903), but is not included in the "Cladocera Sueciæ." I have found it in a pond at Brumstead in company with *Daphnia Atkinsoni*.

" ROSTRATUS, Koch. This is the characteristic Lynceid of the rivers of Norfolk, and it is also fairly common in the Broads.

LEYDIGIA QUADRANGULARIS (Leydig). Fairly well distributed, but only very rarely found in any numbers.

" ACANTHOCERCOIDES (Fischer). Heigham Sounds, Barton and Sutton only.

GRAPTOLEBERIS TESTUDINARIA (Fischer).

ALONELLA EXCISA (Fischer).

" EXIGUA (Lilljeborg). The only previous record of this species admitted by Mr. Scourfield is his own, from Kew Gardens. I have found it myself in Catfield Fen and Sutton and Wroxham Broads. I may also add that it occurs in North Uist.

" NANA (Baird). Sutton, Wroxham, Salhouse, and Ranworth Broads.

PERATACANTHA TRUNCATA (O. F. Muller).

PLEUROXUS LÆVIS, Sars. Sutton, Martham, Barton and South Walsham Broads.

" TRIGONELLUS (O. F. Muller).

" UNCINATUS, Baird.

" ADUNCUS (Jurine). The commonest species of the genus in Norfolk.

CHYDORUS GLOBOSUS, Baird. Rare, but fairly widely distributed.

" OVALIS, Kurz.

" SPHÆRICUS (O. F. Muller).

ANCHISTROPUS EMARGINATUS, Sars. I have only seen a single specimen of this very rare species, and that was taken in Sutton Broad, in a place in which I have collected regularly throughout the year.

POLYPHEMIDÆ.

POLYPHEMUS PEDICULUS (Linn.).

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CIRRIPEDIA.

BALANUS SP? In the Bure, nearly opposite the Muckfleet, there are some piles and planking supporting the bank, and on these I have found large, living specimens of a species of Balanus. In this place, eleven miles from Breydon, the water is generally almost fresh. The nauplii of Cirripedes are often met with in the lower reaches of the rivers, and also in Oulton Broad, but I have not been able to find the adults in any other place than that above-mentioned. If they can live in the Bure in almost fresh water, it is surprising that they should not also live in Oulton, where the water is always distinctly saline.

COPEPODA.

CYCLOPS STRENUUS, Fischer. I have not paid attention to the varieties of this species, but it seems that *C. vicinus*, Uljanin, is the only form found in the Plankton of the Broads. The true *C. strenuus*, which is very variable itself, appears to be confined to the littoral regions and to ponds. It becomes very rare in the Broads themselves during the summer, and is most abundant in mid-winter.

,, LEUCKARTI, Claus.

,, HYALINUS, Rehberg. Generally regarded as a variety of *C. oithonoides*, Sars (=*C. Scourfieldi*, var. Brady). I have not seen *C. oithonoides*, but *C. hyalinus* is widely distributed among the Norfolk Broads.

,, DYBOWSKII, Lande. Sutton, Catfield Fen, Calthorpe and ponds at Sprowston and Herringfleet.

,, BICUSPIDATUS, Claus. In brackish water this species is represented by the variety *Lubbockii*, Brady, with only fourteen joints in the first antenna. This variety occurs in the Muckfleet, apparently at all times, whether the salinity is high or low.

,, LANGUIDUS, Sars. I have found this species at Sutton only, where it lives in submerged moss.

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CYCLOPS LANGUIDOIDES, Lilljeborg. Sutton only, in the same places as *C. languidus*. This species, which has only recently been described, does not seem to differ in any respect from the preceding one except in its *antennæ* which are eleven-jointed. It should probably be regarded as a variety of *C. languidus*.

„ VERNALIS, Fischer.

„ BISETOSUS, Rehberg. Has been found by myself at Sutton, and by Mr. Scourfield at Catfield Fen.

„ VIRIDIS, Jurine.

„ DIAPHANUS, Fischer. Taken by Mr. Scourfield in a pond on Mousehold heath (1903, p. 535).

„ VARICANS, Sars. Sutton, Barton, Calthorpe, Catfield Fen, and in the Ant.

„ RUBELLUS, Lilljeborg. In Great Britain this species has only been recorded from the Lake District. In Norfolk it occurs in Sutton, Rollesby and South Walsham Broads.

„ BICOLOR, Sars.

„ FUSCUS, Jurine.

„ ALBIDUS, Jurine.

„ DISTINCTUS, Richard, = C. BISTRIATUS, Koch. (Scourfield, 1903, p. 535). It has been suggested that this form is a hybrid between the two preceding species, and certainly such a view is very plausible. On the other hand, the facts that it occurs so frequently in Norfolk, at all events, that it sometimes occurs without either of the "parent" species; and that it is occasionally found in considerable numbers, are at least evidence that it should be regarded as distinct. I have not been able to rear the larvæ of it to the adult stage, nor have I succeeded in crossing the "parent" species.

„ SERRULATUS, Fischer. I have not attempted to record separately the varieties of this species. Lilljeborg's two species *C. macruroides* and *C. varius* both occur, but I believe they should be regarded as varieties, connected with *C. serrulatus* by intermediate gradations.

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CYCLOPS MACRURUS, Sars. The only place in which *C. macrurus* is at all common is Barton Broad.

„ PRASINUS, Fischer. Very rare. Sutton, Calthorpe and Wroxham Broads, and a pond at Dilham.

„ AFFINIS, Sars.

„ FIMBRIATUS, Fischer. Like the preceding species, rare in individuals but widely distributed.

„ PHALERATUS, Koch. Sutton, Catfield Fen, South Walsham and in a brick pit at Lound Bridge (near Calthorpe).

„ ÆQUOREUS, Fischer. A brackish-water species, only found within the Broads district, in the Muckfleet, and in a ditch by Berney Arms on the Yare. In the Muckfleet it was only noticed at a time of very high salinity.

HARPACTICIDÆ.

ECTINOSOMA CURTICORNE, Bœck. Fairly common in Breydon Water, this species runs a short distance up the Yare, and I have found it also in Oulton Broad.

TACHIDIUS BREVICORNIS (O. F. Muller). In the Yare at Cantley, and in the Bure at Six-mile House. At Cantley the water was at the time, and I believe nearly always is, practically fresh.

„ LITTORALIS, Poppe. This species, which has been described by Mr. Scott under the name of *T. crassicornis*, has, so far as I know, only been recorded in Britain from shore pools in Scotland. In Norfolk it is common in the rivers Bure, Yare, and Waveney, as far up as the salt-water reaches; but it also ranges beyond this limit into fresh water, and has even occurred in South Walsham and Ranworth Broads. It abounds in Heigham Sounds, and is found in the Muckfleet and in Oulton Broad.

CANTHOCAMPTUS STAPHYLINUS (Jurine). Common everywhere in winter, but decidedly rare during the past summer.

„ PALUSTRIS, Brady. In Oulton Broad only, where it was also found by Mr. Brady.

„ MINUTUS, Claus.

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CANTHOCAMPTUS GRACILIS, Sars. Catfield Fen, Ormesby Broad, and a pond at Ingham.

" HIRTICORNIS, T. Scott. Hickling, Barton, and Dilham Broads.

" CRASSUS, Sars.

" TRISPINOSUS, Brady. Next to *C. staphylinus* this is the commonest species of Harpacticid in this district.

" PYGMÆUS, Sars. Not common; its favourite habitat seems to be submerged moss.

" ZSCHOKKEI, Schmeil. I have only a single record of this species—one solitary specimen only, at Sutton.

NITOCRA HIBERNICA (Brady). Tolerably common in the "fresh-water" Broads. Curiously enough it never occurs at Sutton, though it is frequently found at Barton.

MORARIA BREVIPES (Sars). I took a single male which I refer to this species, on May 5th, on Barton Broad; since then I have hunted for it assiduously, but in vain.

MESOCHRA LILLJEBORGII, Boeck. Occurs in brackish ponds at Cley. Though Cley is not in the district prescribed, this species may conveniently be mentioned, as it probably occurs also in the Norfolk rivers.

LAOPHONTE LITTORALE, T. and A. Scott. Once taken at the Yacht Quay in the North river at Yarmouth.

" MOHAMMED, Blanchard and Richard. This species was originally discovered in Algeria, but it has since been taken in North Wales by Mr. Scourfield (1895), and in Scotland by Mr. Scott (1897). There appears to be no further record of it. On September 23rd I took a single specimen in the Muckfleet near the sluices.

DACTYLOPUS TISBOIDES, Claus. Occurs in the Yare as far up as Reedham.

CENTROPAGIDÆ.

DIAPTOMUS CASTOR (Jurine). Sutton, Barton, and Sprowston—only in small ponds and ditches.

" VULGARIS, Schmeil.

" GRACILIS, Sars.

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EURYTEMORA LACINULATA, Fischer. This species is generally regarded as a brackish-water form, but in Norfolk it is found in nearly all the Broads, and, in brackish water, is almost entirely replaced by *E. affinis*.

,, AFFINIS, Poppe. An estuarine, or even marine, species found most abundantly in the lower reaches of the rivers of Norfolk, but extending far up them even into fresh water. I have even taken it once at Sutton and twice at Barton. Roughly speaking, I have found these two species mutually exclusive.

ARGULIDÆ.

ARGULUS FOLIACEUS (Linn.). I have not specially searched for the parasitic Copepods, so that I have only recorded this species when taken swimming free. It seems to be generally distributed. Probably it will be found that such species as *Achtheres percarum*, Nordm., occur upon some of our fresh-water fish, and I should be very grateful if those who have the opportunity would send me specimens of any fish parasites which they may come across.

MACRURA.

PALÆMONETES VARIANS (Leach). This species is a common inhabitant of estuaries and brackish ditches, though it can accustom itself to almost entirely fresh water, and in South Europe is only found in the latter. In Norfolk I have found it in Oulton Broad, the Muckfleet, in the Yare at Seven-mile House, and in brackish ponds and ditches at Cley. In one of these ditches at Cley it was associated with a typically fresh-water fauna, and I imagine the salinity of the water must have been exceedingly low.

SCHIZOPODA.

NEOMYSIS VULGARIS (J. V. Thompson). The distribution of this species is very interesting. It occurs commonly in the rivers Yare, Bure, and Waveney within the strictly estuarine region, and may be found in thousands along their banks. But though it is not

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found in quite fresh water, it occurs in abundance in Hickling, Horsey Mere, Heigham Sounds, and Martham Broad, and doubtless in parts of the Thurne also, though I have not searched for it there. The explanation of its presence in Broads, so far from the reach of the tides, is to be found in the probable existence of salt springs in Horsey Mere. The salinity of the water in Horsey Mere may reach as high as 112 grains of Chlorine per gallon, and it is also very high in the other Broads mentioned. The water of the Thurne west of Potter Heigham is normally too fresh for Neomysis to be able to live in it, so that in the Hickling region Neomysis is practically shut off from the river Bure. At periods of exceptionally high tides, however, it would be possible for it to run up from the Bure, and in this way establish itself in the more or less salt Broads higher up. At such times it does actually extend far beyond its usual range; in fact, I have even taken it on one occasion at Ludham Bridge.

ISOPODA.

HETEROTANAIS, sp. (?). I have taken specimens at Six-mile House on the Bure, and at Reedham in the Yare, of an Isopod which appears to belong to the genus *Heterotanais*, but which does not agree with any species which I can find described.

GNATHIA MAXILLARIS (Montague). This species is commonly found in the Norfolk rivers, on the borderland between fresh and salt water; the only Broad in which it occurs is Oulton.

SPHÆROMA SERRATUM (Fabr.). Distribution as for the preceding species except that it has also been taken in Rockland Broad.

LIGIA OCEANICA (Linn.). Has been found by my brother, Mr. Eustace Gurney, at Reedham, and by myself in a tank of fresh water standing by the river Yare at Berney Arms, and containing *Daphnia pulex*.

ASELLUS AQUATICUS (Linn.). Common everywhere.

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IDOTEA VIRIDIS (Slabber). I am not quite satisfied that my identification of this species is correct, but at all events I cannot make it agree with any other known to me. It occurs in Ploughman's Ham near Lake Lothing, and brackish ponds at Cley.

AMPHIPODA.

GAMMARUS PULEX (De Geer). Very rare in my experience. The only records I have are: Sutton Broad, Barton Broad, Harford Bridges, Sprowston and in the Blackwater river. It seems that it is confined to absolutely fresh water, and is probably common enough in the higher reaches of the rivers.

,, DUEBENI, Lilljeborg. This species takes the place of *G. pulex* in the Broads district wherever the water shows traces of salt. It is abundant in the Hickling region. Some specimens that I have seen appear to show more or less of a transition to *G. pulex*, the uropods particularly being rather less spinous than the type.

,, LOCUSTA (Linn.). Though properly a marine species I have one record of *G. locusta* from the Yare at Reedham in a collection of fresh-water species.

NIPHARGUS PUTEANUS, Koch. Recorded by Dr. S. F. Harmer from a well at Cringleford (1899).

COROPHIUM GROSSIPES (Fabr.). I have taken this species at various places in the Yare and Bure, and have found it particularly abundant on piles in the Bure near the Muckfleet.

,, CRASSICORNE, Bruzel. This species is included on the authority of Mr. Stebbing,* to whom specimens were sent by Mr. R. Scherren. The latter states that they were taken in the Thurne "not far from the Broad which the courts recently declared was not tidal." Its presence there can be more readily explained by the fact that salt water flows down from Horsey, than by the assumption that salt tides flow normally up the Thurne river.

* 'Victoria County History,' Norfolk, vol. i. p. 192.

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MICRODEUDOPUS GRYLLOTALPA, Costa. A few specimens were taken by Mr. R. A. Todd in Ploughman's Ham by Lake Lothing.

DISTRIBUTION.

In the above table,* I have summarised the main facts of distribution within the Broads district; but the table requires some explanation and amplification. I have only included in it such Broads and stations as have been more or less completely worked, and the records given for each Broad are supposed to refer not only to the Broad itself, but also to the ditches immediately connected with it.

It was hoped at the outset that considerable differences might be found to exist between the faunas of the different Broads, corresponding to their evident differences in physical surroundings; but it will be seen that this expectation has not been fully borne out. Most of the common species of Cladocera and Copepoda are generally distributed all over the district, and appear to be indifferent even to extreme differences of salinity and botanical or physical surroundings. Still there are certain species whose range is definitely restricted, and I have dealt with most of these at some length in the preceding list. The only factor influencing distribution which at present can be determined is the salinity of the water, and I believe it to be a factor of great importance.

I propose now to take the Broads mentioned in the table and to show that they fall more or less into groups characterised by certain zoological, or other features.

One group of Broads stands out from the rest as peculiarly distinct. This group includes Hickling, Horsey Mere, Martham, and Heigham Sounds; in other words all the Broads connected with the Thurne above Potter Heigham. I propose to call this the Hickling group. In all these Broads the salinity of the water is very high. In part this high salinity is no doubt due to their proximity to the sea—Horsey Mere, for instance, being only 1¼ miles from the coast; but it is quite impossible to explain the whole of the saltness in this way. As a matter of fact, it can be shown that the source of the salt lies in the Broads themselves,

* I have included in this table a few records for which I am indebted to Mr. Scourfield. These records are not all included in the body of the paper.

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being probably due to salt springs. The great rise of salinity found on proceeding from Heigham Sounds to Horsey Mere can only be explained in this way, and there are probably similar, though smaller, springs in Hickling. Martham Broad probably owes its saltness to a sort of reflux of the Horsey and Hickling water up the Thurne. As a consequence of this high salinity we find the whole group characterised by the presence of *Neomysis vulgaris* and *Gammarus duebeni* in great abundance. The Entomostracan fauna, very poor in species in Horsey Mere, becomes richer in Hickling and Heigham Sounds, and is richest in Martham Broad, which is the least salt of all. The scarcity of species, however, is compensated for by a great abundance of individuals. Unfortunately, I have not been able to give the Broads of this group the attention they deserve, so that my list for them is incomplete. For instance, I have no record of *Tachidius littoralis* from Horsey Mere, but I have little doubt that it actually occurs there, and also in Hickling. The botany of this group deserves more detailed attention than it has yet received; in no other Broads is there such a rich growth of *Characeæ* and of certain species of *Potamogeton*. It would be exceedingly interesting to know if the species of these plants show any dependence upon salinity, whether as regards their distribution or the luxuriance of their growth.

The next natural group is formed by Sutton and Barton Broads and Catfield Fen. This group is not so homogeneous as the first, but its three components possess certain characters in common, which makes it convenient to unite them. They differ as a whole from the Broads of the Bure in their relatively small area of open water, and the consequent absence, except as rare stragglers, of the pelagic species of Daphnia. They resemble each other in the richness of their vegetation, to which is perhaps due the richness of their Crustacean fauna. All three are rapidly "growing up"; in fact Catfield Fen, which consists of a number of large peat holes, now has very little open water indeed. Barton Broad, however, shows more or less of a transition, at all events in its general appearance, towards the open Broads of the Bure. It has been suggested by Mr. H. B. Woodward that this Broad is artificial, owing its existence (as Catfield Fen does) to peat-cutting. The present depth of the water seems very much against such a view, and I cannot believe that the arm which runs up towards

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Neatishead had such an origin. This part of the Broad resembles very closely the "pulks" of Wroxham, being more or less shallow, and having a bottom of soft yellow mud with little vegetation. This type of mud does not occur, as far as I know, in the Northern half of Barton or elsewhere in the group. This South-western arm of Barton is also enclosed by more or less high wooded ground. The fauna shows somewhat of a transition towards the Broads of the Bure in the relative abundance of certain species such as *Ilyocryptus agilis*, and in the presence of *Nitocra hibernica*, which does not occur in Sutton; *Daphnia cucullata* is also fairly frequently met with as a straggler from the river. In one respect this group has some resemblance to the preceding one; both groups are characterised by the presence of large beds of *Chara*, and I do not know of any other Broads in which the *Characeæ* attain to anything approaching the luxuriance which they show in these two groups.

Calthorpe Broad belongs geographically to the Hickling region, but it is quite distinct from the Broads of that region faunistically. It is a small Broad of about five acres, isolated, except for indirect connection by means of ditches with the Waxham Cut leading to Horsey Mere. During the past year the Broad was much grown up with weeds, and the Crustacean fauna was poor. The total absence of *Bosmina longirostris* and *Diaphanosoma brachyurum* is remarkable, since in 1900 both species were abundant, and in 1901 the former was still present in considerable numbers. Possibly the great growth of weed was the cause of their disappearance.

Of the Broads of the Bure, I have not been able to investigate Hoveton, but the others seem to be all more or less alike in all characters. South Walsham and Ranworth, however, may be conveniently separated from Wroxham and Salhouse, in that they are within the reach of the "brackish" species which extend at the limit of their range into fresh water. Thus *Tachidius littoralis* and *Eurytemora affinis* have been found occasionally in both. All these Broads differ from those of the preceding groups in respect of their wooded surroundings, and in having, as a rule, comparatively little weed. In particular the *Characeæ* are, if not absent entirely, at least never seen in any luxuriance.

Ormesby, Rollesby, and Filby Broads form an isolated group,

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being separated from any direct connection with the Bure by the Muckfleet sluices. They have a rich pelagic fauna, and probably the apparent scantiness of the littoral fauna is only due to insufficient search.

The records under the head of the Muckfleet only refer to the lower part of it, close to the sluices. At this point the dyke widens out into a large, shallow pool thickly grown up with weed, which is for the most part *Myriophyllum*, and it is here that most of my collections have been made. The Muckfleet is peculiarly interesting, owing to the great fluctuations of salinity to which the water is subject. On the three occasions on which the water has been analysed, the salinity was 19·59, 235·09,* and 24·48 grains of Chlorine per gallon, the salinity in the river outside the sluices being at the same times 12·24, 39·18, and 20·81 respectively. It seems probable that the salinity in the Muckfleet changes slowly, so that if it is raised very high by slow infiltration of water during exceptional tides in the river, it will remain at this high level after the river salinity has sunk to the normal. The changes in the fauna correspond largely to the changes in the composition of the water. There is a constant fauna represented by a few common Copepods and by *Gammarus duebeni*, but at times there may be found species evidently derived from the upper fresh-water reaches, such as *Daphnia cucullata*, and at others those derived from the river, belonging to the brackish-water fauna. Among the latter are *Neomysis*, *Palæmonetes*, and *Cyclops æquoreus*. *Tachidius littoralis*, though a marine type, can adapt itself to fresh water, and is therefore a constant inhabitant.

The two columns devoted to Fritton and Sprowston districts contain records from ponds and ditches only, most of the ponds being ordinary farm ponds. The "Fritton" district lies South of Fritton Lake, and includes Herringfleet, Lound, and Blundeston. The "Sprowston" district includes Rackheath, Thorpe, and Sprowston.

Oulton Broad is one of the most interesting Broads of the district. The salinity of its water, though subject to great fluctuations, is always high, so that its fauna is not rich, and is made up for the most part of brackish-water species. There

* A month previous to the day on which this analysis was made there was an exceptionally high salt tide in the river.

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is a tide of nearly two feet, coming from the Waveney, but apparently all the *salt* comes through the locks from Lake Lothing; at all events, the salinity is highest at the East end of the Broad. In many places the shores are covered with *Enteromorpha*, in which lives *Sphæroma serratum*.

Rockland and Surlingham Broads I have only twice visited, so that my list of their Crustacea is no doubt very incomplete. They appear to have few species but immense abundance of individuals. In particular, *Pleuroxus aduncus* was found in extraordinary abundance in both Broads, though it is by no means a very common species in other parts of the district. They are both "fresh-water" Broads, though they are tidal.

Seasonal Distribution of the Cladocera.

I have given here a table showing the months during which the various species have been found to occur, and also the months in which sexual forms appeared. Two columns are devoted to each month; in the first column a cross indicates simply that the species occurred during that month; in the second column are given the total number of records of males and ephippial females throughout the past year.

Such a table shows at a glance what species are found all the year round, and what species only appear in the summer; but it does not show their relative abundance at different times. Some idea of relative abundance might be given by presenting all the records of each species during each month, but there are great objections to this method. The only satisfactory method would be to give the total number of records for each month expressed as percentages of the whole number of collections taken. Quantitative methods, such as are used in the study of Plankton, are not available when dealing with the Cladocera as a whole, since the majority of them are littoral species, living among weeds or in mud.

Observations carried on throughout a whole year, and tabulated in this way, are certainly of some value taken by themselves, but it is highly probable that, if carried on for a series of years, variations in the dates of appearance and disappearance of species and in their relative abundance might be found, dependent upon meteorological conditions. For instance, the relatively high temperature of March may have caused several species to appea

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earlier than usual, while the wintry weather of April may have retarded others. The period of sexual activity, also, may prove to have been influenced by the quite abnormal summer of the past year. It will be seen that the species increased rapidly in number from February onwards and reached their maximum in September, the number being maintained in October, but then suddenly decreasing. The maximum of sexual activity occurred in October.

The table is necessarily open to error in one respect. It has not been possible to collect in the same places, or to take the same number of collections every month; consequently there are gaps which might otherwise have been filled, and these gaps affect the number of species recorded. However, I believe the error from this source is not very material.

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SEASONAL RECORDS OF CLADOCERA.

[1st column, bare record; 2nd column, number of sexual records].

	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
Acroperus harpae	†		†		†		†		†		†		†	1	†	1	†		†	10	†	5	†	2
Alonella excisa							†		†		†	2	†		†	1	†		†		†		†	
„ exigua															†		†		†	1	†			
„ nana	†				†		†		†		†	3	†				†		†		†		†	
Anchistropus emarginatus																	†							
Bosmina longirostris	†		†		†		†		†		†	12	†	2	†		†	2	†	1	†		†	
Camptocercus lilljeborgii													†		†		†		†	2				
„ rectirostris									†				†		†		†		†	1	†	1		
Ceriodaphnia affinis											†	1	†				†	2	†	1				
„ laticaudata									†		†	1	†	1	†		†	1	†	2	†			
„ megalops									†				†	1	†		†		†	8	†	1		
„ pulchella	†						†		†				†	5	†		†	3	†	13	†	4	†	2
„ quadrangula					†		†		†				†		†		†	2	†	4	†	3	†	
„ reticulata			†		†		†		†		†	1	†	7	†	1	†	4	†	11	†	5		
Chydorus globosus									†		†		†		†		†		†		†		†	
„ ovalis	†		†		†		†		†		†		†		†		†	1	†				†	
„ sphaericus	†		†		†		†	2	†		†	1	†		†		†		†		†		†	
Daphnia atkinsoni											†	1			†	1			†		†	1		
„ cucullata											†		†	2	†		†	1	†	4			†	
„ lacustris											†		†		†		†		†		†		†	
„ longispina	†		†		†		†	1	†	4	†	6	†	7	†	2	†	4	†	1	†	5	†	1
„ magna					†						†	6	†	1	†	1	†		†	2	†		†	
„ pulex	†		†		†	1	†	2	†	4	†	3	†	2	†	2	†	6	†	8	†	7	†	2
Diaphanosoma brachyurum							†		†		†		†		†	5	†	10	†	6				
Eurycercus lamellatus	†		†		†		†		†		†		†		†		†		†		†		†	
Graptoleberis testudinaria					†		†		†		†		†		†		†		†	2	†	2		
Ilyocryptus acutifrons											†		†		†				†					
„ agilis					†		†				†		†				†		†					
„ sordidus					†		†		†		†		†		†		†		†		†			
Lathonura rectirostris	†		†		†		†		†		†		†		†		†		†		†		†	
Leydigia acanthocercoides									†				†		†	1	†							
„ quadrangularis							†		†		†		†		†	1	†		†	1	†		†	
Lyncus affinis	†		†		†		†		†		†		†		†		†		†	1	†		†	
„ costatus					†		†		†		†		†		†		†		†	8	†	2		
„ guttatus	†		†		†		†		†		†		†		†		†		†		†			
„ quadrangularis	†		†		†		†		†		†	1	†	1	†		†		†		†		†	
„ rectangulus									†		†		†		†		†	2	†	4	†			
„ rostratus							†		†		†		†		†		†		†	3	†	1		
„ tenuicaudis													†		†		†	1	†					
Macrothrix laticornis																			†					
Moina rectirostris																			†		†			
Peratacantha truncata															†	1	†				†			
Pleuroxus aduncus					†		†		†		†		†		†		†		†	5	†	3	†	
„ laevis	†						†		†		†		†		†		†		†		†		†	
„ trigonellus											†		†		†		†		†				†	
„ uncinatus	†		†		†		†		†		†		†		†		†		†		†	1	†	
Polyphemus pediculus					†		†		†		†		†		†		†		†		†		†	
Scapholeberis aurita					†		†		†		†		†	2	†		†		†	7	†	3		
„ mucronata																	†	2	†	3				
Sida crystallina							†		†		†		†	2	†		†	6	†	5				
Simocephalus exspinosus					†		†		†		†		†		†		†		†	11	†	3		
„ vetulus															†		†	1	†		†	1		
	†		†		†		†		†		†		†		†	1	†		†		†		†	

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earlier than usual, while the wintry weather of April may have retarded others. The period of sexual activity, also, may prove to have been influenced by the quite abnormal summer of the past year. It will be seen that the species increased rapidly in number from February onwards and reached their maximum in September, the number being maintained in October, but then suddenly decreasing. The maximum of sexual activity occurred in October.

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SEASONAL RECORDS OF CLADOCERA.

[1st column, bare record; 2nd column, number of sexual records].

	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		
ACROPERUS harpae	†		†		†		†		†		†		†	1	†	1	†		†	10	†	5	†
ALONELLA excisa							†		†		†	2	†		†	1	†		†		†		†
,, exigua															†		†		†	1	†		
,, nana	†				†		†		†		†	3	†				†		†		†		†
ANCHISTROPUS emarginatus																	†						
BOSMINA longirostris	†		†		†		†		†		†	12	†	2	†		†	2	†	1	†		†
CAMPTOCERCUS lilljeborgii													†		†		†		†	2			
,, rectirostris									†				†		†		†		†	1	†	1	
CERIODAPHNIA affinis											†	1	†				†	2	†	1			
,, laticaudata									†		†	1	†	1	†		†	1	†	2	†		
,, megalops											†		†	1	†		†		†	8	†	1	
,, pulchella	†								†		†		†	5	†		†	3	†	13	†	4	†
,, quadrangula					†		†		†		†		†		†		†	2	†	4	†	3	†
,, reticulata			†		†		†		†		†	1	†	7	†	1	†	4	†	11	†	5	
CHYDORUS globosus									†		†		†				†		†		†		†
,, ovalis	†		†		†		†		†		†		†		†		†	1	†				†
,, sphaericus	†		†		†		†	2	†		†	1	†		†		†		†		†		†
DAPHNIA atkinsoni											†	1			†	1			†		†	1	
,, cucullata											†		†	2	†		†	1	†	4			†
,, lacustris											†		†		†		†		†		†		†
,, longispina	†		†		†		†	1	†	4	†	6	†	7	†	2	†	4	†	1	†	5	†
,, magna					†						†	6	†	1	†	1	†		†	2	†		†
,, pulex	†		†		†	1	†	2	†	4	†	3	†	2	†	2	†	6	†	8	†	7	†
DIAPHANOSOMA brachyurum							†		†		†		†		†	5	†	10	†	6			
EURYCERCUS lamellatus	†		†		†		†		†		†		†		†		†		†		†		†
GRAPTOLEBERIS testudinaria					†		†		†		†		†		†		†		†	2	†	2	
ILYOCRYPTUS acutifrons											†		†		†				†				
,, agilis					†		†				†		†				†		†				
,, sordidus					†		†		†		†		†		†		†		†		†		
LATHONURA rectirostris	†		†		†		†		†		†		†		†		†		†		†		†
LEYDIGIA acanthocercoides									†				†		†	1	†						
,, quadrangularis							†		†		†		†		†	1	†		†	1	†		†
LYNCEUS affinis	†		†		†		†		†		†		†		†		†		†	1	†		†
,, costatus					†		†		†		†		†		†		†		†	8	†	2	
,, guttatus	†		†		†		†		†		†		†		†		†		†				
,, quadrangularis	†		†		†		†		†		†	1	†	1	†		†		†		†		†
,, rectangulus									†		†		†		†		†	2	†	4	†		
,, rostratus							†		†		†		†		†		†		†	3	†	1	
,, tenuicaudis													†		†		†	1	†				
,, elegans																			†				
MACROTHRIX laticornis																	†		†		†		
MOINA rectirostris															†	1	†				†		
PERATACANTHA truncata					†		†		†		†		†		†		†		†	5	†	3	†
PLEUROXUS aduncus	†						†		†		†		†		†		†		†		†		†
,, laevis											†		†		†		†		†				†
,, trigonellus	†		†		†		†		†		†		†		†		†		†		†	1	†
,, uncinatus					†		†		†		†		†		†		†		†		†		†
POLYPHEMUS pediculus					†		†		†		†		†	2	†		†		†	7	†	3	
SCAPHOLEBERIS aurita															†		†	2	†	3			
,, mucronata							†		†		†		†	2	†		†	6	†	5			
SIDA crystallina					†		†		†		†		†		†		†		†	11	†	3	
SIMOCEPHALUS exspinosus																	†	1	†		†	1	
,, vetulus	†		†		†		†		†		†		†		†	1	†		†		†		†

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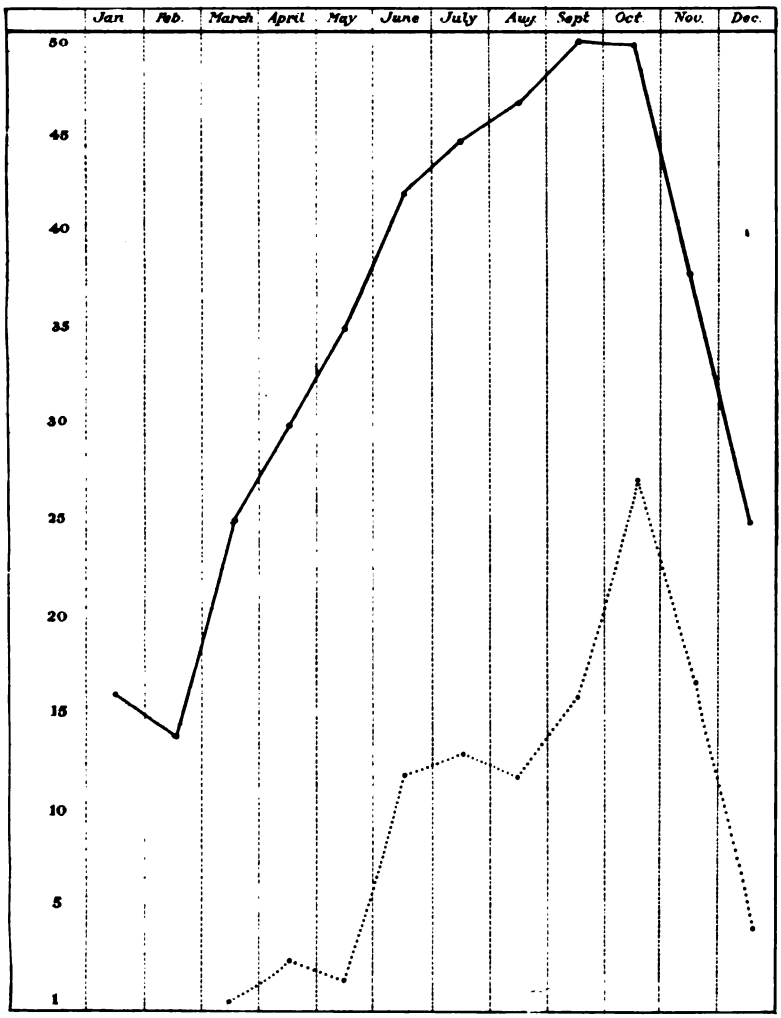

Unbroken line = Total number of Species.
Dotted line = Number of Species sexual.

TABLE SHOWING RELATIVE ABUNDANCE OF SPECIES AND INTENSITY OF SEXUAL REPRODUCTION OF CLADOCERA IN THE DIFFERENT MONTHS OF THE YEAR 1903.

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TABLE OF DISTRIBUTION—CLADOCERA.*

	Sutton.	Barton.	Catfield Fen.	Hickling.	Whitesley.	Heigham Sounds.	Horsey Mere.	Martham.	Caithorpe.	South Walsham.	Ranworth.	Salhouse.	Wroxham.	Ormesby.	R. Ilesby.	Muckfleet.	Oulton.	Fritton.	Fritton district.	Sprowst. n district.	Surlingham.	Rockland.
ACROPERUS harpae	†	†	†						†	†	†	†	†		†						†	†
ALONELLA excisa	†		†																	†		
,, exigua	†		†										†									
,, nana	†	*									†	†	†									
ANCHISTROPUS emarginatus	†																					
BOSMINA longirostris	†	†	†	†	†	†		†		†	†	†	†	†	†	†	†	†				
CAMPTOCERCUS lilljeborgii	†		†																			
,, rectirostris	†	†									†		†	†	†							
CERIODAPHNIA affinis	†	†	†					†					†									
,, laticaudata	†		†	†		*		†					†						†			
,, megalops	†	†	†							†	†		†						†			
,, pulchella	†	†	†	†	†	†			†	†	†	†	†		†	†	†	†	†		†	†
,, quadrangula	†	†	†	†	†	†			†	†	†			†	†			†	†		†	
,, reticulata	†	†	†					†	†				†						†	†		†
CHYDORUS globosus	†	†	†			*			†	†	†		†		†				†	†		
,, ovalis	†	†	†	†						†		†										
,, sphaericus	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
DAPHNIA atkinsoni																			†			
,, cucullata	†	†								†	†	†	†	†	†			†	†			
,, lacustris		†								†				†	†			†				
,, longispina	†	†	†	†	†	†		†		†	†		†	†	†	†	†	†	†	†	†	†
,, magna																			†	†		
,, pulex	†	†	†	†				†	†				†						†	†		
DIAPHANOSOMA brachyurum	†	†	†							†	†		†	†	†			†			†	
EURYCERCUS lamellatus	†	†	†	†		*			†	†	†	†	†			†			†		†	†
GRAPTOLEBERIS testudinaria	†	†	†						†	†	†	†	†								†	†
ILYOCRYPTUS acutifrons	†												†									
,, agilis	†	†									†		†		†							
,, sordidus	†	†				†	†		†	†	†	†	†	†			†					
LATHONURA rectirostris	†	†	†						†				†									
LEYDIGIA acanthocercoides	†	†				†																
,, quadrangularis	†	†				†			†	†			†						†			
LYNCEUS affinis	†	†	†		†	†	†	†	†	†	†	†	†	†	†						†	†
,, costatus	†	†	†	†						†		†	†		†							
,, guttatus	†	†	†										†	†	†			†				
,, quadrangularis	†	†	†	†	†				†	†	†	†	†	†	†			†				†
,, rectangulus	†	†	†			†				†	†		†	†	†	†		†		†		†
,, rostratus	†		†						†	†	†	†	†	†								†
,, tenuicaudis	†		†	†															†			
MACROTHRIX laticornis																			†	†		
MOINA rectirostris																			†	†		
PERATACANTHA truncata	†	†	†						†	†	†	†	†		†							
PLEUROXUS aduncus	†	†	†	†		†		†	†	†	†	†	†				†	†			†	†
,, laevis	†	†						†		†												
,, trigonellus	†	†	†	†		†			†		†								†	†		
,, uncinatus	†	†							†	†	†		†								†	†
POLYPHEMUS pediculus	†	†	†	†	†			†	†	†	†	†	†		†						†	†
SCAPHOLEBERIS aurita			†							†									†			
,, mucronata	†	†	†		†				†	†	†	†	†			*			†	†	†	†
SIDA crystallina	†	†								†	†	†	†	†								†
SIMOCEPHALUS exspinosus	†	†	*																†			
,, vetulus	†	†	†	†	†	†	†	†	†	†	†	†	†			*	†		†	†	†	†

* N.B.—Records marked thus * I owe to Mr. Scourfield. They refer to years *previous* to 1903.

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TABLE OF DISTRIBUTION—COPEPODA, &c.*

	Sutton.	Barton.	Catfield Fen.	Hickling.	Whiteley.	Heigham Sounds.	Horsey Mere.	Martham.	Calthorpe.	South Walsham.	Ranworth.	Salhouse.	Wroxham.	Ormesby.	Rollesby.	Muckfleet.	Oulton.	Fritton.	Fritton district.	Sprowston district.	Surlingham.	Rockland.
CANTHOCAMPTUS crassus	†	†	†														†					
„ hirticornis		†		†																		
„ gracilis			†											†								
„ minutus	†	†	†						†		†			†	*		†			†		
„ palustris																*	†					
„ pygmaeus	†	†	†																			
„ staphylinus	†	†	†	†					†	†	†	†	†	†		†	†	†	†	†	†	†
„ trispinosus	†	†	†				†	†	†	†	†	†	†	†	†	†	†	†			†	†
„ zschokkei	†																					
CYCLOPS aequoreus																†						
„ affinis	†	†					†		†	†	†	†	†	†								
„ albidus	†	†	†	†		†	†	†	†	†	†	†	†	†		*	†	†			†	†
„ bicolor	†	†	†				†	†	†				†									
„ bicuspidatus	†	†	†			†										†			†	†		
„ bisetosus	†		†																			
„ distinctus	†	†	†						†				†									†
„ dybowskii	†		†						†										†			
„ fimbriatus	†	†	†								†		†	†			†		†	†		†
„ fuscus	†	†	†			*		†	†				†								†	†
„ hyalinus	†	†						†	†	†	†		†	†	†			†				
„ languidus	†																					
„ languidoides	†																					
„ leuckarti	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†		†	†		†	†
„ macrurus	†	†										†	†	†	†			†				
„ phaleratus	†		†						†													
„ prasinus	†								†				†									
„ rubellus	†								†						†							
„ serrulatus	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
„ strenuus	†	†	†	†	†	†	†		†	†	†	†	†	†	†	†	†	†	†	†		
„ varicans	†	†	†						†													†
„ vernalis	†		†																	†		
„ viridis	†	†	†	†	†	†	†	†	†	†	†	†	†		†	†	†	†	†	†	†	†
DIAPTOMUS castor	†	†																		†		
„ gracilis	†	†	†	†	†	†			†	†	†		*	†	†		†	†	†			
„ vulgaris	†	†	†		†				†	†	†					†	†	†	†			
ECTINOSOMA curticorne																	†					
EURYTEMORA affinis	†	†		†	†	†	†			†	†					†	†					†
„ lacinulata	†	†	†	†	†	†	†	†	†	†	†	†	†			†	†	†			†	†
MORARIA brevipes		†																				
NITOCRA hibernica		†	†		*					†	†	†	†	†	†			†				
TACHIDIUS littoralis					†	†				†	†					†	†					
NEOMYSIS vulgaris				†		†	†	†								†	†					
GAMMARUS duebeni				†	†	†	†	†								†	†			†		
„ pulex	†	†																				

* N.B.—Records marked thus * I owe to Mr. Scourfield. They refer to years *previous* to 1903.

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IX.

A BIONOMICAL INVESTIGATION OF THE NORFOLK BROADS.

By Frank Balfour Browne, M.A., F.Z.S.

Read January 26th, 1904.

Bionomics, or the study of the inter-relationship between living forms and also between them and their physical environment, is a branch of Biology which may almost be said to owe its existence to the work of Darwin. It was not until after the publication of the theory of Natural Selection that biologists began to recognise that Natural History was not only a collector's hobby, but a subject capable of considerable expansion. The idea of a struggle for existence led to a closer observation of animals and plants in their natural surroundings, and the main principles of the Darwinian theory having once been accepted, it became the object of naturalists to render an explanation of every observed phenomenon in living organisms.

The changed outlook upon life also led to a collecting mania, and for a time scientific literature consisted largely of lists of species, which were of less value from the fact that often a hastily made collection would be described under the title of the Fauna or Flora of the locality visited.

However, the new interest in Biology gradually settled down into an earnest enquiry, and methodical research took the place of desultory exploration. The Marine Fauna attracted a large number of naturalists owing to its richness, and in 1874 the first Marine Biological Station was inaugurated at Naples. Since that time Biological Stations for Marine Research have sprung up in many places throughout Europe and America. I need only mention the Plymouth Laboratory, Port Erin, Millport on the Clyde and the Gatty Marine Laboratory as some of those in Great Britain.

Fresh-water research had been carried on by Leeuwenhoek, Rosenhof, Swammerdam, Reaumur and many others before the

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new era commenced; but it was for some time almost neglected under the new regime except for a few independent workers, such as Fritsch in Bohemia, who, about 1871, began his limnological investigations and Forel in Switzerland, who commenced his studies upon the Lake of Geneva about the same time. The investigations of Weismann on Lake Constance, Apstein upon the Holstein Lakes, of Imhof on the pelagic fauna of the Swiss Lakes, and Zschokke on the biological characters of elevated lakes have all been done more or less recently, and are examples of the work done by independent observers.

It was probably in connection with fish culture that the first laboratories for fresh-water research were instituted; but the first permanent station for the biological investigation of inland waters was, I believe, that at Plon, founded, in 1891, upon the same principle as the Marine Laboratory at Naples, by Dr. Zacharias, the present director.

To-day there are permanent fresh-water stations in France, Germany, Hungary, Russia, Denmark, Finland and in America. Great Britain does not figure among the countries possessing one, but the survey of the fresh-water lochs of Scotland, at present being carried out under the direction of Sir John Murray, is a co-operative undertaking, which, although primarily bathymetrical and only secondarily biological, is a move in the direction of a Biological Institution.

Except for this survey, I believe no organised work has been carried out in Great Britain as far as fresh-water biological research is concerned, and contributions towards the knowledge of the life and physical conditions of inland waters other than those of Scotland have been most meagre.

Through the opening of the Sutton Broad Laboratory, the opportunity has now arisen of carrying out definite research upon the Bionomics of the Norfolk Broads, a district which, in the agitations which have from time to time been raised for the founding of a British fresh-water station, has been specially suggested as suitable for such an institution.

Mr. Gurney's desire with regard to the Sutton Broad Laboratory is, that it should serve, as far as possible, the purposes of a Fresh-water Biological Station, and since I have been in charge of the establishment I have been given an entirely free hand to develop

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some line of work by which to carry out the objects of the Laboratory.

The ultimate problem, as I conceive it, of a Fresh-water Biological Station should be the Bionomics of the district it serves, and the question for me to decide was how that problem was to be attacked, and in looking through the literature upon the subject, it appeared to me that the most direct assault had been made in America. Now the chief object of most of the American stations has been to advance Fishery questions, and some of the State Fishery Commissions and Universities and occasionally the United States Commission of Fish and Fisheries have instituted co-operative research into bionomical problems, some of the stations having been actually inaugurated for this purpose.

For instance, in the Biennial Report of the University of Illinois Prof. Forbes lays down the objects of the Station thus :—"To put a foundation of precise and comprehensive knowledge of the system of aquatic life under the practical art of the fish culturist and further to study the forms of life, both animal and vegetable, in all their stages of a great river system as represented in carefully selected typical localities. This study must include their distinguishing characters, their classification and variations, their local and general distribution and abundance; their behaviour, characteristics and life histories; their mutual relationships and interactions as living associates, and the interactions likewise between them and the inanimate forms of matter and of energy in the midst of which they live. We are, in short, to do what is possible to us to unravel and to elucidate in general and in detail the system of aquatic life in a considerable district in the interior of North America."

With these objects in view various sub-stations were fixed upon in the Illinois districts, and the physical and botanical characters of these sub-stations were noted. Work has been done on the Protozoa, Rotifera, Worms, Crustacea, Insects and Plankton of the district by various naturalists, and papers on the various groups have been produced.

With all respect to the authors, I think they have paid more attention to their species than to the local distribution of those species, and there appears to be much required before the bionomic objects of the station are in a fair way to being carried out.

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A biological examination of Lake Michigan and of Lake St. Clair undertaken by a party of biologists under the auspices of the Michigan Fish Commission, and a biological survey of Lake Erie undertaken by the United States Fish Commission are two more examples—and there are others—of the adoption of co-operation in working at the problem of bionomics with the ultimate object of improving the Fisheries.

Now in this country fisheries, other than salmon, have up to the present, received very little attention, and coarse fish, such as Pike, Carp, Bream, Roach, &c., are not a staple food here as similar species are on the Continent, and in America. Angling, however, is largely on the increase, and the day may come when our coarse fish are reared in hatcheries with the same care and attention as is at present given to the Salmonidæ; the work which we are undertaking may therefore later on be directly useful to the pisciculturist, but, apart from this possibility, it has I submit, a greater biological value, and the method of attacking the problem which commends itself to me is that adopted by the Biological Station of Illinois—with modifications.

I propose to investigate the local distribution of living organisms in a district not too large, but that it may all be conveniently worked from the Sutton Broad Laboratory and yet large enough to be divided up into a number of sub-districts, the fauna and flora of which must be recorded. Now this is an immense scheme of work and one which cannot be carried out in a single season, nor yet by a single individual, and it is with a view to getting members of this Society to co-operate with me that I am laying the matter before you to-night.

Now, I may say at once that I expect the result of our efforts in tabulating the species in these sub-districts will be summed up after perhaps several years' work in the following words, words used with regard to the distribution of insects on the Illinois river and adjacent waters:—"It is not too sweeping a statement to say that the full lists for each station of every species observed there . . . . do not conspicuously differ. On the other hand, variations in relative abundance of the forms at each station and of the total life of each, with the presence or absence of some prominent species or group of species, impart an individuality to each station."

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In other words, we shall find numbers of species of the various groups cosmopolitan in the district, but it is not these species which will directly concern us. It is safe to say that some species will be present in one part of the district and absent from another, and I think it highly probable that the distribution of a species will vary from season to season. The variation in the distribution of one species will probably involve a rearrangement of other species, and thus I hope that from year to year we shall find interesting changes going on in the fauna and flora, and that such observations will indicate to us definite problems of inter-relationship to be solved.

I conceive that most of the bionomical work which has been done up to the present time has been carried out "piece-meal." Small problems, chosen without any reference to their connection with the problem of the general struggle for existence, have been investigated, and have failed to give us results of intrinsic value. By first surveying the whole struggle as carried on within a limited district, it seems to me that we can select the problems worthy of inquiry and that the investigation of such problems will have a definite value in relation to the whole question of bionomics. It is the inter-relationship of a species with all those with which it comes in touch that is the ultimate problem, not merely its relationship with its food or with those species which prey upon it, and the question *why* a species has a localised distribution is only to be answered by discovering the part it takes in the great struggle for life. This, I submit, may be done by tracing its distribution over a small area in conjunction with that of all other species which live with it side by side, and which may or may not affect its existence.

For such a scheme of work as that which I have laid before you the District of the Norfolk Broads is eminently suitable. We have a series of Broads all connected more or less intimately into one system by waterways in which the water flows scarcely quicker than in the Broads. Round many of these Broads and along most parts of the rivers and dykes connecting them are extensive marshes, and in these marshes and their environs are numerous small waterways draining the land.

The District of the Norfolk Broads was defined by Lubbock ('Observations on the Fauna of Norfolk, 1879,' pp. 78 and 79), as

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contained within lines drawn from Happisburgh to Norwich, and from Norwich to Lowestoft, thus including part of Suffolk, and Mr. Robert Gurney in his paper upon the Crustacea of the Norfolk Broads has dealt with the district as thus defined. But for such an extended piece of work as that I am submitting to you—a scheme which involves the recording of at least the prominent groups of the fauna and flora, and in fact of as much of the whole system of life as possible—I think a somewhat smaller district will, at any rate at first, be more convenient, and I therefore propose to limit the investigation to a district including only those Broads connected with the rivers Bure, Ant and Thurne. This is all within convenient reach of the Sutton Broad Laboratory and some part of it at least is not far from Norwich.

For our purpose I propose to divide this district into twenty-four sub-districts, purely as a matter of convenience and without any reference whatever to faunistic or physical characteristics. This partitioning off of the ground is, in my opinion, all the more necessary, as I believe the Broads themselves are not the richest parts of our district faunistically, the dykes through the marshes and, for flying forms, the marshes themselves being more fully stocked. I think therefore that in describing the locality of capture of any species it is sufficient to name the sub-district. By adopting this method, the fauna and flora can be tabulated in twenty-four columns, one column representing each sub-district, and the distribution of any species can be seen at a glance, and, I believe with sufficient accuracy for our immediate purpose.

Besides this tabulation of the distribution, we shall require records of the time of appearance and duration of the various forms and of relative abundance, and any other noticeable facts. One species of a genus may be dominant in one locality, whereas another species of the same genus may be dominant in another. Such a case actually occurs among the Dragon-flies, but I will refer to this again when dealing with the distribution of these insects.

Now, though I have arbitrarily divided the district into twenty-four sub-districts, I do not think that it is either necessary or possible to work all these thoroughly. I do not hope, of course, to exhaust the fauna and flora of any sub-district; that would require a large staff of workers devoting their whole time to the work; but I want to get at least the more prominent groups

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recorded year by year. I believe that the recording of even a few groups will give us very interesting results, and we may possibly, apart from the bionomics, get some valuable information as to the influence of physical conditions upon local distribution. However, the first point to my mind is to get as many instances as possible of localised distribution within our district and then proceed from that knowledge to enquire into the causes of such distribution.

I believe that if about ten of the stations—chosen so as to fairly represent the whole district—are worked thoroughly, they will give us most of the material we require. I do not suggest that the remaining fourteen sub-districts should be studiously avoided, but it must be remembered that the non-discovery of a species is not such good evidence of its non-occurrence as its capture is of its presence, and that in consequence it will be necessary to take considerable trouble to get as reliable a list as possible in the ten primary sub-districts. Records of the occurrence of species in the intermediate secondary sub-districts will be useful as extending the distribution of these species, but the absence of such records need not be taken as showing the limits of the species.

I propose to consider the following ten sub-districts as primary: Sutton, Catfield Fen, Ranworth, Wroxham, Burgh or Muck Fleet, Ormesby, Calthorpe, Hickling, Horsey and Martham, regarding the remaining fourteen sub-districts as secondary.

Now in order to convince you that there is such a phenomenon as local distribution in the selected district, I will refer to the small amount of work which has so far been done. Mr. Scourfield has from time to time, since 1890, visited the district for the purpose of collecting Entomostraca, and has kindly placed his list of captures at the disposal of the Laboratory. From his list and that of Mr. Robert Gurney, who has done most of his work, though not all, during the last year, I have tabulated the local distribution of the Cladocera and Copepoda so far as it affects our district—(the records of the Ostracods are not sufficiently complete to include)—and the results are very much in accordance with those obtained for insects in Illinois. I have further tabulated the results of last season's work to which Mr. Scourfield contributed in September, and I find that for the ten primary sub-districts, thirty-one species were not taken in localities where they were previously found. Of these, seven were not found in Hickling, one in Horsey, three in Calthorpe, fourteen in Martham, one in Ormesby, one in Burgh,

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and two each in Wroxham and Ranworth. With regard to the fourteen secondary sub-districts, as many as fifty-three species were not recorded last season from districts where they have previously been found, but of these, records of twenty-seven were wanting from Potter Heigham and nine from Ludham, two districts which had very little attention paid them last year. I do not propose to refer to all these species which have apparently changed their locality, but reference to one or two examples will suffice.

In the summer of 1900 *Diaphanosoma brachyurum* was abundant at Calthorpe, but it was absent last summer.

In June, 1902, *Bosmina longirostris* was quite common at Calthorpe, whereas last summer it was not to be found.

Diaptomus gracilis did not occur at Wroxham last season, although previously recorded from there.

Ceriodapnia laticaudata, *Chydorus globosus*, *Eurycercus lamellatus*, *Cyclops fuscus*, and *Nitocra hibernica* — five species previously taken in the Heigham sub-district, were not found there last season.

Now all these apparent changes in local distribution may be the result of insufficient investigation, but Mr. Gurney has told you of his work which he carried on throughout the season, and although possibly his lists are not complete, I do not think that this explanation will entirely cover the case. I hope at the end of the present year he will be able to compare his results with last year's work and perhaps show further changes in the local distribution of the Entomostraca.

Mr. Soar has done some work upon the Hydrachnids of the Norfolk Broads, but his records up to the present time are few in number. Out of the list of forty-six species which he has sent me he has found thirty-one in the neighbourhood of Potter Heigham. I hope, however, at the end of the present year he will have a fairly complete list of the local distribution, at any rate, in the ten primary sub-districts.

I have, during the past season, been working at the distribution of the Dragon-flies, and the result, so far as the Zygopterids—(thin-bodied, weak-flying species) — are concerned, is decidedly encouraging.

As you probably know, the Dragon-fly egg is laid in the water, either directly upon some solid object under the surface, or dropped at random and allowed to sink. From the egg, after a few weeks, emerges what is known as a nymph, which moults several times

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during its existence which is supposed to last about eleven months, though I have reason to believe it often lasts considerably longer. During the nymph stage the insect feeds voraciously, in the case of the large thick-bodied species upon insect larvæ, worms, tadpoles, small fishes and large crustacea, such as *Asellus* and *Gammarus* and in the case of the smaller thin-bodied forms upon Entomostraca —I believe chiefly the Cladocera—and minute insect larvæ. When full grown, the nymph climbs out of the water and clings to some support, the skin on the back of the thorax splits and the perfect insect emerges. The perfect insect feeds upon winged insects and almost certainly only lives two or three months.

We have thus in the Dragon-fly an insect which spends the greater part of its life under water, and which is carnivorous in both its nymphal and imaginal stages. From our point of view, therefore, the nymph is virtually a different insect from the imago, living in a different element and feeding therefore upon different food. The swimming and walking powers of the nymph are very limited, and I think it is safe to conclude that its presence in any sub-district is satisfactory evidence of the occurrence there of the imago also. The reverse case, of course, will not necessarily hold, but, with regard to the weak-flying Dragon-flies included under the Zygopteridæ, I think we may conclude that in the locality where the imago is, the nymph also lives. Of course, in either case it is not safe to rely upon the occurrence of one or two individuals as indicating local distribution; but such records will, I hope, either become established in successive seasons or be shown to have been accidental.

With regard to the larger Dragon-flies—the Anisopterids—I have, I regret to say, insufficient facts to say anything as to their local distribution; the perfect insects are very swift upon the wing and are therefore very difficult to capture, and the nymphs are not always easy to find. A few facts as to the time of appearance and duration of life of the imagoes are worthy of our notice.

The earliest species on the wing were *Brachytron pratense* and *Libellula quadrimaculata*. These both occurred towards the end of May. The former was abundant at Sutton throughout June, although, like all the insects then about, it received a slight check from the frost on June 12th. After the first week in July it seemed to disappear. The second species persisted through July and was to be found in the beginning of August.

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Aeschna isosceles, an insect confined to the fen districts, appeared about the middle of June and was common enough for about a month, its place being then taken by *Aeschna grandis*, which was about until the first or second week in September.

Orthetrum cancellatum and *Libellula fulva* were about in July, and both, I believe, appeared some time at the end of June. The former species which was very common round Sutton and Barton and Ranworth, and perhaps elsewhere, seemed to disappear suddenly about the beginning of August, although I found one or two specimens much later.

Sympetrum striolatum I first recorded on July 16th, after which it became very common and was to be found fairly abundantly during the first fortnight of October.

Aeschna juncea I did not find until August 19th, although I heard of its occurrence at the end of July.

I will now pass on to the Zygopterids—the small thin-bodied Dragon-flies of which nymphs, at least of some species, are common, and the perfect insects are easily captured. There are only fifteen species of these Dragon-flies found in Britain, and of these the Victoria County History records nine as being found in Norfolk. Of these nine I have only found six, but I have been able to add four more to that list and therefore my facts as to distribution concern only ten species.

Only one of these ten species is cosmopolitan in the district, and it is apparently common enough everywhere. This species is *Ischnura elegans* and was on the wing during the whole season, that is from May until October.

Another species, *Agrion pulchellum*, may later on prove to be generally distributed, but it is not uniformly common, apparently having its centre in the eastern half of the district, while another species of the same genus, *Agrion puella*, predominates in the western half. This latter species, during last season, had two particularly crowded centres, one at the west end of Barton Broad and the other on the west side of Wroxham Broad. I only took one specimen of this latter species at Sutton and one at Calthorpe, both, curiously enough, on the same day. It does not appear to occur at all in any of the other eastern sub-districts.

The records of these two species stand entirely upon the collection of perfect insects, as so far I have been unable to distinguish between the nymphs.

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One other species of Agrion has come under my notice and that is *Agrion armatum*, Meyer, of which I took two specimens ♂ & ♀ at the end of May at Sutton. This species has not hitherto been recorded as British, although Mr. Edelsten tells me that he found it in the same locality in 1902.

A species, *Enallagma cyathigerum*, has its centre on the Hickling, Horsey, and Martham Broads, and also occurs as the commonest species at Calthorpe. It is also to be found at Sutton, Barton and Dilham on the Ant, and I have found a few specimens of the nymph at Acle Bridge on the Bure. The species, however, does not apparently occur west of Ant mouth on the Bure. The perfect insect frequents the edges of the open water of the Broads more than the other species, but in the autumn, that is about August, it deserts the open water and is to be found along the dykes.

Possibly *Erythromma naias* will also ultimately turn out to be generally distributed, although up to the present I have only found it in seven out of the twenty-four sub-districts. It, however, occurs at Sutton, Calthorpe, Hickling and Wroxham, a wide enough range, although I believe that like *Agrion pulchellum*, it has its centre in the eastern portion of the district.

I believe the range of *Lestes sponsa* agrees very much with that of *Enallagma cyathigerum* already referred to. It is a late insect, appearing on the wing about the middle of July and remaining in evidence well on into September. I first found the nymph at the beginning of June, after which it became very common. Although I searched for the imago in the Wroxham sub-district during August, the height of its season, I failed to find it, and I neither found imago nor nymph anywhere above Ant mouth on the Bure.

Pyrrhosoma nymphula is one of the earliest species on the wing, appearing about the middle of May. It also seems to have a short existence, as I did not find it after the end of June, and I fear therefore that my record of its distribution is more incomplete than that of other species. I have, however, found the nymph in several localities, and putting all the records together, I failed to find the species at Hickling, Horsey or Martham, but otherwise it seemed to be fairly generally distributed.

The other species of this genus, *Pyrrhosoma tenellum*, is

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apparently confined to the Dilham sub-district. I only visited this locality during July, but having found the species there I searched for it in other localities and without success.

One other species has apparently a very limited area of distribution and that is the handsome *Calopteryx splendens*. It is fairly common on the Bure between Belaugh Broad and Bridge Broad, and seems to get scarcer down the river as far as Wroxham Broad, below which I never saw it.

Now in considering all these records of local distribution of the Dragon-flies, it must be borne in mind that they are the result of only one season's work, my first season in the district, and one in which I was consequently somewhat handicapped by not knowing my ground. I do not for that reason lay too much stress upon the accuracy of the results, but I do not think that my observations can have been so inaccurate as to discover a local distribution where there was nothing of the kind. I hope, therefore, that you have heard enough to be satisfied that there is a basis for the scheme which I have propounded to you, and I also hope that it will receive your hearty support.

I do not expect members of this Society who have other things than Biology to attend to, to take up large sections of the work. The more assistance I can get the more thorough will the work be; but I shall be glad to receive help with regard to the distribution of species of any group of animals or plants, or even with regard to the distribution of any one species. In fact, any reliable information upon the question will be welcome, as will also any suggestions with regard to the scheme which I have laid down.

I myself hope, during the coming season, to elucidate the facts of distribution of the aquatic and semi-aquatic beetles on which I have already done some work and also of the Trichoptra or Caddis-flies, of course noting at the same time the Dragon-flies.

We have, therefore, made a start in what I hope will become a valuable piece of work, but it can only become valuable by continued observation and massing of facts from season to season, and I hope that if we can unite this Society and the Sutton Broad Laboratory in the working out of this problem, we may be able to obtain results which will not only be a credit to the Society and the Station, but will also add sound facts to our knowledge of the intricacies of the Struggle for Existence.

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ODONATA Zygopteridae. 1903.	1 Sutton.	2 Catfield Fen.	3 Ranworth.	4 Wroxham.	5 Burgh.	6 Ormesby.	7 Calthorpe.	8 Hickling.	9 Horsey.	10 Martham.	11 Dilham.	12 Barton.	13 Irstead.	14 Ludham.	15 Belaugh.	16 Hoveton.	17 South Walsham.	18 Upton.	19 Acle.	20 Thurne.	21 Rollesby.	22 Potter Heigham.	23 Heigham.	24 Waxham.
Calopteryx splendens (Harr.)				†											†			‡				‡		
Lestes sponsa (Hansemann.)	†	†			†		†	†				†											†	
Erythromma naias (Hansm.)	†		†	†			†	†				†			†									
Pyrrhosoma nymphula (Sulz.)	†	†		†	†		†					†				†								
„ tenellum (Vill.).											†													
Ischnura elegans (Lind).	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	‡	†	†	†	‡	†	†
Agrion pulchellum, Lind.	†	†	†	†	†		†	†	†	†		†	†		†		†							
„ puella (L.) - -	*		†	†			*					†			†									
„ armatum (Meyer.)	†																							
Enallagma cyathigerum (Charp.)	†				?		†	†	†	†	†	†						‡	†	†	†	‡		

* A single imago in each subdistrict. ‡ Subdistricts not examined.

ODONATA Anisopteridae. 1903. May—October.	May.	June.	July.	August.	Sept.	October.
Sympetrum striolatum (Charp.) -			†	†	†	†
Libellula quadrimaculata, L. -	†	†	†	†		
„ fulva, Mull. - - -		?	†			
Orthetrum cancellatum (L.) -		†	†	†		
Brachytron pratense (Mull.) -	†	†	†			
Aeschna juncea (L.) - - -			?	†	†	
„ grandis (L.) - - -			†	†	†	
„ isosceles (Mull.) - -		†	†			

ODONATA Zygopteridae. 1903. May—September.	May.	June.	July.	August.	Sept.
Calopteryx splendens (Harr.) -			†		
Lestes sponsa (Hansem.) - -			†	†	†
Erythromma naias (Hansem.) -		†	†	†	
Pyrrhosoma nymphula (Sulz.) -	*	*			
„ tenellum (Vill.) -			†		
Ischnura elegans (Lind.) - -	†	†	†	†	†
Agrion pulchellum, Lind. - -	†	†	†	†	
„ puella (L.) - - -		†	†		
„ armatum (Meyer.) - -	†				
Enallagma cyathigerum (Charp.) -		†	†	†	†

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X.

SWITZERLAND AND ITS BUTTERFLIES.

June 20th—July 27th, 1903.

By the Rev. A. Miles Moss, M.A.

Read 23rd February, 1904.

Once again am I honoured by the Secretary's request for a paper on my Entomological observations in Switzerland during my last year's summer holiday, spent as before at Villars-sur-Ollon, where I held the chaplaincy for some six Sundays in June and July.

Bad weather has for too long been the order of the day, and the region of the Rhone valley during the summer of 1903 was no exception in this matter. It was wet on my arrival at Villars, and it rained the whole of the next week without intermission. It rained at intervals of two or three days in every week which followed; July concluding in the same unsatisfactory manner as June, with a week wet throughout.

This was a decided damper on one's entomological projects; but all things considered I really had a very pleasant time, made several long day excursions and met with fair success in the matter of Lepidoptera.

Being a fortnight earlier than in the previous year I had hoped to forestall the haymakers and turn up several species hitherto unnoticed; but I had forgotten to reckon with the elements.

True, I added largely to my list of 1902, but most of the new species were noted later on in July. In fact the 10th and 13th of that month were record days, eclipsing any occasion in the previous year in the number of species observed and in the general abundance of Butterflies in the particular locality under inspection. This was the hill slope below Gryon in the direction

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of Bex, a district which I had formerly overlooked, and known as the Bois du Sublin. No less than forty-six species of Butterflies did I detect here; and including the Moths and chance larvæ observed my list totalled at least sixty-four species.

Beetles and Flies of every description were in great abundance and the ground was alive with the perpetual chirrup of the Grasshopper and Cricket.

A certain Lime tree in full flower, situated on a provokingly steep grassy bank, was the great attraction to many Butterflies and its fragrance drew from far and near. It was hot and fatiguing work, this Lime-blossom hunting, for an excited plunge with the net after some coveted beauty generally entailed the loss of one's balance and a precipitate rush into a thicket of hazel at the bottom of the bank. This disturbance sometimes acted beneficially for it produced a kind of general post in the Lime, the greater portion of which was altogether out of my reach; and when the momentary panic, which had filled the air with a thousand wings of every form and colour, had subsided, the feast was resumed on a more accessible bough.

There was only one much coveted specimen of *Limenitis populi* which defeated all attempts at capture, and after soaring round the top of the tree like our well-known Purple Emperor it flew away. This grand species is of frequent occurrence in the district, and I was singularly unfortunate in not being able this year to procure one specimen, good, bad, or indifferent. To add to my annoyance it was, if one may trust their description, always *the* Butterfly my friends at the hotel had seen while I was out, and had tried in vain to capture.

Let me enumerate some of the visitants at the Lime-blossom. There were *populi's* two congeners, the White Admirals, *L. sibylla*, somewhat worn in appearance, and the still more beautiful and newly emerged *L. camilla*, with its snowy-white design upon a background of the most intense blue-black. Then amongst the Fritillaries four species were abundant, *A. paphia*, *adippe*, *aglaia* and *niobe*. *Paphia*, the silver-washed fritillary, seldom came within reach, so that I only managed to net three or four specimens. Four other species turned up in the same locality, *M. cinxia* and *athalia*, a lovely series of the richly-toned *didyma*, which was plentiful among the grass and quite new to me, and

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a couple of *A. dia*. It was noteworthy that these, in company with many others of different genera, including the Whites, Clouded Yellows, Blues and Skippers, showed no partiality for lime juice and absolutely ignored the seductive bloom, preferring the commoner hay flowers.

The tree, however, was an irresistible attraction to the great *Satyrus hermione*, a Butterfly in colour and markings like our common Grayling, but much more intense and almost twice the size. This again was a new species to me, and it was a truly magnificent sight to behold over a score of these glorious creatures careering round the branches, and ever and anon settling on some choice spray. Several times I netted three or four at one stroke, only to let them go again, for I could afford in this instance to be fastidious, and only took a series of specimens in perfect condition for the cabinet. Others of the same order visited the tree, including *Satyrus ianira*, *Pararge mœra*, and *P. achine*, a delicately fashioned Ringlet which was new to me, and was generally to be taken flitting gently along the border of the hazel wood and always seeking the shade of branches.

Another fresh find was *Satyrus cordula*, a splendid black Butterfly like a very large Meadow Brown, the male, however, being considerably darker. This species was taken in plenty in this one district, but always amongst the grass, never on the tree.

Before leaving the Lime tree, I must not forget to mention the lively brown Hairstreak which frequented it in numbers. I took it at first for *L. pruni*, but find now that it is the allied species *ilicis*. Its congener *L. quercus* also was present, but was commoner on the boughs of several small oak trees which grew close at hand. On the same bank I caught a specimen of the famed *Parnassius apollo*, the first I had seen near Villars. I captured also a fine specimen of the common Swallow-tail, and immediately afterwards discovered a full fed larva of the same species on a plant of *Angelica sylvestris*. I had the same experience with *G. rhamni*, seeing the Butterfly and soon after finding a full grown larva on buckthorn. *Erebia melampus*, *C. pamphilus* and *iphis*, *E. hyperanthus* and *M. galatea* were common everywhere; so also was *C. hyale*, the pale clouded yellow, and I caught sight of an odd specimen of *C. edusa*.

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The grass culms again were literally alive with Blues of several kinds, especially the brilliant *L. damon*, which occurred in great abundance; and I was able for the first time to secure the more sombrely-clad female of the species, which last year escaped my notice. The Blues also included *L. corydon*, *dorylas*, *icarus*, *alsus* and *acis*, and the larva of some species. The Skippers were represented by *H. linea*, *sylvanus*, *N. tages*, *S. malvæ* and *alveus*, and one specimen of *H. sao* on the border of a vineyard, about half a mile lower down.

The *Vanessas* though not strongly represented were most of them seen in this district, including *urticæ*, *polychloros*, *C-album*, an odd specimen of *io* and probably *atalanta*, but no Camberwell Beauties did I see. *C. phicomone* was taken in company with *hyale*, also *A. cratægi*, *P. rapæ* and *L. sinapis*.

Then amongst the Moths, I was fortunate enough in the same ground to come across a new species of Burnet, *Z. carniolica*, a gaudy little creature and locally plentiful. The other species of the genus were *Z. trifolii*, *filipendulæ* and *minos*. Several larvæ of different orders were picked up here, including a couple of *N. trepida* off the oak, a small *S. tiliæ* found on my coat sleeve, and presumably shaken from the Lime tree, and finally a full grown caterpillar of the common Emperor Moth, *S. carpini*, feeding on some common weed and looking quite out of place. I do not pretend to have exhausted the possible list of species which were to be found on this sunny hill-side—in fact I took or recognized at least some dozen others—but I must hasten on to speak of other occasions when the sun was good enough to show his face.

I made expeditions from Villars on every point of the compass when the weather permitted and sometimes even when it did not, returning on one occasion drenched to the skin, much to the amusement of my unfeeling friends in the hotel who were sitting in the hall on my arrival engrossed with bridge and tea.

Several times I revisited Solalex in the valley between the Diablerets and Argentines with the hope of procuring a row of *Parnassius delius*, having taken a specimen here in 1902. But though I was evidently in the right district for the species, I only got two specimens, one perfect and the other too worn to set. There was plenty of its food plant (*Sedum aizoides* and *telephium*)

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growing amongst the wet rock and loose stones at the foot of the Argentines cliffs.

Near the cheese farm at Solalex I obtained three specimens of a new and interesting Blue, *L. alcon*, a single specimen of *Euchlöe belia*, a fresh series of *C. phicomone*, and higher up in the neighbourhood of Anzeindaz a series of the Chequered Skipper, *C. palaemon*. Here also I took *E. melampus*, *C. satyrion*, several Blues and Skippers and a specimen or two of the mountain Fritillary, *Brenthis pales;* also a delicate yellow geometer, *Cleogene lutearia*. I saw, but failed to catch, a couple of White Butterflies flying swiftly over rocky ground, where it was impossible to run: they were in all probability *Pieris callidice*.

By the manure heaps at farms on this expedition I secured several good Skippers, notably *Spilothyrus althæ*, which with the Blues and even such noble creatures as the Swallow Tails, not to mention a host of the Coleopterous tribe, were possessed of what we consider depraved tastes, and were often to be seen sipping the juices from some dark-coloured and strong-scented pool.

In the upland district of Bretaye and Chamossaire about the same elevation as Anzeindaz, I again took *Brenthis pales*, but not commonly, and a couple of the interesting smoky variety of the Green Veined White, known as *Bryoniæ*, and a specimen of a plain grey Skipper, which I believe to be *Syricthus cacaliæ*. Amongst the *Eribias*, *lappona* was always to be found high up in the hills, *æme* a little lower, and the lovely *ligea* in company with *stygne*, *blandina* and *melampus* in open glades, and on the roadside bordering woods everywhere. In the previous year I took single specimens of *goante*, *gorge* and *euryale*, but failed to notice these species again.

One one occasion, I made a long day's excursion, covering between twenty-five and thirty miles, descending first in the direction of Aigle and then diverging through a never-ending pine wood towards Sepey, which I finally reached about 2 p.m.

The road between Aigle and Sepey in said to be specially famed for Butterflies, but with the inordinate length of my ramble I had not the time to give it an adequate test. I did however pick up several things of interest—one *P. apollo* and a worn Bee Hawk, *H. bombyliformis*, two fresh specimens of *P. achine*, numerous

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Fritillaries, all previously mentioned, and a dozen Black Veined Whites, netted at one stroke as they congregated to sip from a puddle at the roadside.

One realised with what enthusiasm such a record capture as this would be received here in England—twelve *cratægi* at one blow—but as this was not England they were promptly released.

About 3 p.m. on the same day, I spotted a specimen of the scarce Swallow Tail, *Papilio podalirius*, the first I had seen, and caught it. It was indeed a straggler in tattered condition, but I retained it as a long-looked-for and welcome addition. May and June are its months, and I believe it is then by no means uncommon.

I missed the lie of the country on my home journey, and instead of making direct for the Lac des Chavonnes I added some eight or ten miles to my walk, which could well have been spared; and when eventually I reached the little wooden restaurant by the lake it was seven o'clock, and the prospect of no dinner after the day's toil caused my movements for the next three-quarters of an hour to be unpleasantly rapid.

Another day took me down to the Rhone valley, where the great swollen river bore testimony to the abundance of rain in the hills, from which I have reason to believe the valley itself was on many occasions exempt; for from out of the mists and rain-clouds of Villars we used to see the sun shining on the corn-fields below.

For a mile or two I walked along the bank of the river, which like some living monster enchanted me, so swift and strong was the current and yet so strangely silent, bearing down from the glacial regions tons upon tons of gravel and grey mud in suspension.

The chief Butterflies here noted were *A. paphia* and the other common Fritillaries, *M. galatœa* and *E. hyperanthus*, all previously observed.

I cannot omit the mention of several other species of interest taken for the most part on the roadside, or on the meadow lands close to my hotel. *A. cratægi* was as plentiful as ever, and this year I was in time to procure some backward larvæ on small Mountain Ash trees, well nigh stripped of their leaves by a colony of this gregarious species. *C. hyale* too was very common, and was in rather better condition than those of July, 1902. The common Whites with *L. sinapis* and *E. cardamines* were of

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frequent occurrence. In a damp meadow behind the hotel I took the larvæ of three different Fritillaries, viz.:—eight or ten of *A. ino* feeding on Meadow Sweet, one *B. amathusia* and some thirty *A. aglaia* in different stages of growth on a species of Sorrel which grows abundantly in the field. I also found the larvæ of *M. athalia* in another place. Before I left Villars *ino* emerged from the pupæ, and on revisiting the meadow I was able, as I had anticipated, to net a complete series in perfect condition. The *aglaia* did badly on the whole: always restless and feeding up very slowly in captivity. Many pupated, but on emergence they resulted in undersized and abnormally blotched specimens, more or less crippled. In the same district I took several fresh Coppers, viz.:—a series of *P. hippothöe* and one *P. thersamon*, and in addition to some of the Blues already mentioned *L. arion*, *ægon*, *agestis*, *dorylas*, *adonis*, and a good series of the sombre-coloured *eumedon*. I spotted two specimens of the dainty *A. latona*, several *selene* and *euphrosyne* and odd specimens of *N. lucina* and *P. egeria* which were worn and evidently out of season. A solitary larva of *V. C-album* was taken feeding on hazel and a small batch of *polychloros* on a weeping willow at Vevey.

Long and diligent search on the species of honey-suckle which grows extensively throughout the district was well repaid, though *L. camilla* seemed scarce, and I only procured two larvæ, both of which died, and a couple of *pupæ*, one producing a parasite.

The plant was however productive of other things and afforded one some interesting work for even wet days. Besides some half-dozen other species I found a few larvæ of the Lilac Beauty, *P. syringaria*, and on one memorable small bush by the roadside, I took from sixteen to twenty pupæ of the species, curious stumpy little creatures slung perpendicularly tail downwards with a few silken threads attaching them to the bare stems.

Ova and larvæ of the broad bordered Bee Hawk were also found, and I was greatly interested on one occasion in watching some passé females of *L. sibylla* depositing eggs singly on the honey-suckle leaves.

I thus secured some sixteen ova, which hatched, but soon died; with the exception of one which is still a small larva $\frac{1}{8}$th of an inch long in its hibernaculum. Burnet Moths of three or four species were to be seen in every field; also occasional specimens of the

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bronze-coloured Forresters, *Ino statices* and *geryon*; and the Humming Bird Hawk was observed, both moth and caterpillar. Nor must I forget to record the many larvæ of *B. trifolii* which were found dead on the road. They were too fond of leaving their food amongst the grass on the bank in order to sun themselves in the dry warm dust, the result being that numbers had their heads chopped off on the electric tram lines in company with numerous Beetles and Crickets. Three or four *D. fascelina* and one striking-looking larva with the appearance of an *Acronycta* were also found close to the road.

Several species I am still unable to determine, but for the sake of completeness I will conclude with merely enumerating some not before mentioned.

Larvæ.—*P. monacha* (1); *M. castrensis* or an allied species in any quantity; *T. cratægi*, some dozen on low-growing mountain Alder; *A. caia*, several; *D. pudibunda* (1); *P. pigra* (1); *L. camelina* (1); *D. vinula*, several; *C. exoleta*, several; *A. pyramidea* (1); *P. meticulosa* (1); *N. depuncta* (2); *C. verbasci*, several; *P. moneta*, eight or ten, some in cocoon.

Moths.—*S. pyri*, one found at Bex in early June and given to me dead, *L. quadra* (1); *rubricollis*, several; *deplana* (1); *N. russula* (1); *plantaginis*, several; *S. fuliginosa* (1); *A. menthastri* (1); *L. testudo* (2); *H. hectus* (1); *A. cæcimacula* (1); *C. umbratica*, several; *lactucæ* (1); *A. tincta* (1); *R. detersa* (1); *M. leucophæa* (2); *D. conspersa* (1); *H. serena* (1); *P. bractea* (1); *P. iota* (1); *E. glyphica*, *mi* and *œnea*, several; *C. elocata* (1); *P. quadrifaria*, several; *S. dealbata*, several; *E. bipunctaria*, several; *G. obfuscata*, several; *A. præformata*; *C. atrata*, several; *I. immorata*; *A. luteata* (2); *A. prunaria* (2); *O. bidentata* (1); *E. angularia* (1); *I. vernaria* (1); *S. clathrata* and an allied species, several; *L. turbata*, *tristata*, *subtristata*, *ferrugata* and an unknown species, several of each; and several of the *Boarmia* genus.

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XI.

NOTES ON THE HERRING FISHERY OF 1903.

By T. J. Wigg,

Honorary Secretary Great Yarmouth Section.

Read 23rd February, 1904.

Once more it falls to my lot to give an account of this most important industry, when Yarmouth, especially the southern part, is given up to the bustle, turmoil and excitement of the Herring Fishery. The business becomes larger and more extended as the fame of Yarmouth spreads abroad. The Herring voyage was again a successful one, and though the Scotch fleet operating at Yarmouth had a heavy diminution in its catch, our own boats caught and landed more than ever.

The following is taken from the *Fish Trades' Gazette* (which has long recognised the importance of this port for the development of the Herring trade):—"Yarmouth, from its geographical situation, appears, so far, to be more favoured than other places in the way of regular supplies. There have been bad and good years there, as elsewhere, but the bad years, so far as my memory serves me, were never for want of Herrings. The late season of the year at which the fishing takes place makes the work more liable to be interfered with by stormy weather, and the bad seasons in the past have been mainly attributable to atmospheric influences. Whether the revolution which has taken place of late years in the Yarmouth and Lowestoft fishing, and nearly doubled the fleet of boats in East Anglian waters, will have any effect in sending the shoals further out to sea remains to be seen. Sufficient, however, for the day is the evil thereof, and meantime those interested in the great industry cannot stop to theorise, but must make the most of things as they find them."

This year Herrings were landed at the Wharf in August, but during September the arrivals of local boats were very numerous, and heavy catches were made.

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Since the last fishing season, several steam drifters were added to the Yarmouth fleet, and with the arrival of the Scotch boats the Harbour officials were very busy during the first week in October mapping out the room available for the vessels.

More ground on the South Denes had this year been allotted for the army of men and women engaged in the preparation of the Herrings for export.

Referring to the coming of the gutting lassies, as they are best known by in the trade, a correspondent says:—"The girls are usually engaged by Scotch firms under season engagements before they leave home. Physically, they are of sturdy build, with more of brawn and muscle than feminine feebleness about them. They work in the open-air for the most part, but they have every appearance of robust health for all their laborious toil. They adapt their garments to their work and the weather, and are all marked by the same sober, sedate, and serious characteristics. Their lives are very hard ones. From the time they are able to handle a gutting-knife, they are sent out from the little villages that stud the Moray Firth and other parts of the Scotch coast. From the time the fishing starts at Stornoway, in May, they go the rounds of Lewis, Shetland, or Orkney, for the early fishings; then to Aberdeen, Fraserburgh or Peterhead for the Lammas fishings, next to Grimsby and Scarborough, and finish their year at Yarmouth and Lowestoft. They are a thrifty and industrious class, and, though plainly dressed, are always comfortably clad. They have been well cared for and strictly brought up at home, and, with exceptions, are distinctly a religious class. Their early home training has much to do with the exemplary conduct they always show when amongst strangers. They have now become quite familiar figures at Yarmouth during the autumn, and command universal respect."—*Eastern Daily Press.*

The year 1902 was a very remarkable one for the Herring Fishery. The effect was the storing of a record catch; but the result of this glut was not good for the Herring trade. This was clearly proved by the report received from continental markets.

Owing to the stormy weather experienced in October, the Scotch fleet were unable to do much, and their share in the work of the fishing was comparatively small. This had the effect of bringing enforced idleness upon many of the Scotch women, and in

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consequence, their earnings compare very unfavourably with the season of 1902. The bad luck of the Scotch fleet was the means of enabling the English boats to have the run of the market day after day, much to the annoyance of Scotch buyers, who, in many cases, were obliged to pay more for their supplies than they had bargained for. The stormy weather previously mentioned was responsible for the loss of a considerable number of nets from various boats, and also for the early return to the North of scores of the smaller Scotch boats, which are not built to stand rough weather, and had been lying idle in the harbour for weeks. Indeed, it is asserted that many of them never once left the harbour in search of Herrings, or put their nets over the side owing to the continuance of bad weather. However, as the boats did fairly well before reaching this coast they did not return home empty-handed.

I have this year to note the great loss of nets which has fallen heavily on some of the boat owners. Several boats lost the whole fleet, while others report the loss or spoiling of more than half of their nets.

During the third week in November, an attempt was made by a number of Scotch curers at Yarmouth to limit the Herring output. A circular was issued containing a suggestion that "it is in the interest of both fishermen and curers that the present fishing be now wound up." Most of the merchants and others concerned in the fishing took but little notice of the circular. Such an action is unprecedented in the fishing trade so far as Yarmouth is concerned, and it is needless to say that it has excited the indignation of both English and Scotch salesmen, as well as the fish merchants of Yarmouth. One of the latter in speaking of the circular described it as "the biggest piece of nonsense ever sent out."

The earnings of the Scotch boats average less than last year, and of fifty boats which returned to Fraserburgh, the average earnings are less than £100. A steam drifter from the same port delivered 700 crans of Herrings, but only realised £350. Several other Scotch boats have averaged only £80 per boat, which is a big falling off on last year, and will affect the trade and cause much depression and distress. The failure of the fishing so far as the Scotch boats are concerned was entirely due to bad weather. With light winds the catch would have been very heavy.

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The local boats appear to have made good catches, but this is chiefly owing to the fact that the boats are heavier and able to withstand the sea better, and also that they hurry from the harbour at any time, not even excepting Sunday, when all Scotch boats are in the harbour.

The quantity of Herrings landed at Lowestoft has been very much less than last year, and prices have ruled considerably lower. Several causes may be given for this. The fish were off the coast much earlier than usual, and the number of boats prepared to go to sea to catch them was larger than ever; but for weeks the weather was so bad that the Scotchmen were unable to go to sea, and the local boats made fewer trips than they would have done under more favourable conditions. The result was that for some weeks the supply of Herrings at the Market was thousands of lasts per week less than last season. What this means in value may be judged by the fact that on last year's excellent prices a last of Herrings meant about £10.

With regard to the lower prices which fish have fetched this season, there is no doubt that this is chiefly accounted for by the fact that many merchants, both in this country and on the Continent, have not yet disposed of the Herrings which they accumulated last year, and they are naturally chary of increasing their stock.

As will be seen from the following figures, Yarmouth still appears to be the favourite port for Scotch boats. They comprise 166 from Banff, Kirkcaldy 87, Inverness 63, Fraserburg 57, Leith 46, Peterhead 37, Wick 35, Berwick 35, Aberdeen 16, Stornoway 2, Dundee 1, Granton 1. In addition to these North Shields sent 27, Hull 8, Grimsby 2, Sunderland 1, and Southampton 1.

The fiscal policy of the Government has stirred the Emden Fishermen's Union to answer the question put to them by the German Government. The present tax on salt Herrings is three marks per barrel. Raw Herrings are admitted duty free. The Government wanted to know if the duty could be increased, and received a reply in the negative. Last year 1,877,379 barrels were imported into Germany, of which 756,547 came from Great Britain, and 451,464 from the Netherlands. The exports from Germany were only 3,294 barrels.

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I am again indebted to the courtesy of Mr. W. L. Smith, the Borough Accountant of Great Yarmouth, and to Mr. H. J. Henderson, the harbour master of Lowestoft, for the returns of Herrings landed at those ports, and also to Mr. H. D. Sayers for particulars of boats sailing out of Yarmouth during the fishing.

I give the following figures of the landings for the past ten years, as I think they will be useful for comparison.

Year.	Lasts.	Year.	Lasts.
1894	17,407	1899	26,395
1895	16,471	1900	28,483
1896	18,977	1901	28,690
1897	22,493	1902	44,059
1898	18,392	1903	39,777

In the ten years preceding 1894 the highest catch was 23,872 lasts, and the lowest in 1891 was 13,386.

RETURN OF HERRINGS LANDED AT YARMOUTH IN 1903.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	282
February	—	July	147
March	7	August	1,274
April	80	September	3,070
May	75	October	11,962
June	120	November	19,694
		December	3,348
Carried forward	282	Total	39,777

Number of Yarmouth boats employed, about . 178
„ Scotch and other boats employed, about 585

RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1903.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	1,403
February	—	July	157
March	73	August	28
April	836	September	674
May	292	October	7,434
June	202	November	13,251
		December	3,236
Carried forward	1,403	Total	26,183

Number of Lowestoft boats . . . 345
„ Scotch „ . . . 344

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XII.

METEOROLOGICAL NOTES, 1903.

(From observations taken at Bradestone House, Brundall, Norfolk.)

By Arthur W. Preston, F. R. Met. Soc.

Read 23rd February, 1904.

January.

The year entered with a continuance of the mild weather which had characterised the latter part of the previous December. On the 3rd there were heavy hailstorms accompanied by thunder, and on the 5th and 6th maxima of 53.4 and 52.5 were attained by the thermometer. On the 12th a drop occurred in the temperature, and a week's somewhat winterly weather ensued, with a little snow, but the frost was at no time severe, and on the 20th milder weather again set in, and continued till the end of the month, the thermometer reaching 54.8 on the 26th. On the mean the temperature for the month was 3.3 above the average, and much the same as that of the previous January. The rainfall was .21 ins. deficient, and the prevailing direction of the wind was from westerly quarters. It blew strongly on many days. Owing to the continued mildness, some of the earlier spring flowers, such as violets, primroses, aconites, and snowdrops came into bloom early in the month.

February.

Great mildness prevailed throughout the month, maxima of 57 degrees being recorded on the 8th, 20th, and 21st, and on the 9th the thermometer touched 58.6. There were but few frosts, and on the mean the temperature of the month was 6.1 degrees above the average. It was a very dry month, only .34 ins. of rain being recorded, and the first three weeks were practically rainless. There was no snow whatever, and by the close of the month vegetation was forwarder than in any year since 1882. Early wall fruit, such as apricots, began to blossom before the close of the month, and the whitethorn commenced to leaf at an unusually

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early date. Going back 130 years it would seem that February was warmer only four times, viz., in 1869, 1850, 1794, and 1779, but in 1846 it was about as mild. The wind was almost continuously from the west, and blew hard at times, particularly between the 19th and 27th.

MARCH.

This was another extremely mild and windy month, the mean temperature being as much as 4.7 degrees above the normal. It was the warmest March since 1882, and at the close of the month vegetation was forwarder than since that year, even more advanced than in the warm seasons of 1893 and 1894. The rainfall was about the average, but, as in February and part of January, much windy weather prevailed, the prevailing direction having been from the south, south-west, and west, caused by constant cyclonic disturbances of great violence passing from the Atlantic beyond the north of Scotland to Scandinavia. Happily the tremendous downpours of rain which accompanied these disturbances in the west did not reach East Anglia. The spectacle of fully-formed apricots on the trees, and of asparagus, potatoes, and beans showing above ground in the month of March is of unusual occurrence, but was in evidence before the close of the month under review.

APRIL.

Never was the "promise of spring" more ruthlessly thwarted than in this month. After a few days of medium temperature, with the advent of Easter came a totally different type of weather to that which had prevailed for so many weeks, and the country, with its full-blossomed fruit trees and gay flower gardens, was suddenly plunged into midwinter. Snow fell to a greater extent than it had all through the winter season, it being recorded on six consecutive days, measuring, when melted, .68 ins., representing 6½ inches of snow on the level. There were frosts nightly, and on the 20th morning the exposed thermometer fell as low as 19.1 degrees. There was no return of mildness till quite the end of the month, and the results of the cold spell upon the fruit crop was so disastrous that it was practically ruined. The mean temperature of the month was 2.8 degrees below the average, and it was the coldest April since 1891. It was 2.5 degrees colder than March,

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and nearly a degree colder than February, whereas in an ordinary year April should be 5.4 degrees warmer than March, and 8.1 degrees warmer than February. The rainfall of the month was .84 ins. above the average.

MAY.

The month opened with some fairly warm days, but the weather turned cold again on the 9th, and continued so till the 21st, when a period of fine dry weather set in till the end of the month. The thermometer reached 70 degrees on the 21st, and 75.2 degrees on the 22nd, but after the last-named date the maxima were lower owing to the wind settling into the east. On the mean the month was warmer than any May since 1895, but the excess above the average temperature was not much. No rain was recorded here after the 17th.

JUNE.

The "easterly wind" type of weather, which had set in on May 23rd, continued till June 14th, when frequent shallow barometric depressions, which had already caused heavy rains in the south for some days, produced a considerable downpour in this neighbourhood. It rained daily from the 13th to the 20th inclusive, the total amount measured during that period having been as much as 2.42 ins., or practically the whole rain of the month, no more having fallen after the 20th day. During this rainy period (which, however, yielded much less rain here than in the vicinity of London, where 6 ins. and more were recorded), the temperature was very low for the time of the year, and the weather was of the most ungenial description. The last ten days were very fine and bright, and on the 28th the thermometer reached 86 degrees in the shade, constituting that day the hottest in the year, and the warmest ever recorded here in June. Up to the end of this month the total rainfall for the year was half an inch deficient.

JULY.

The fine, dry weather which followed on the rainy period in the middle of June, continued till July 18th, or for exactly four weeks, during which there was scarcely any rain, and many warm days, although, in July, the maximum temperature only

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once exceeded 80 degrees. From the 18th to the end of the month another very rainy period set in. Rain fell daily, and on many days the falls were very excessive. On the 23rd, no less than 2.28 ins. fell in the 24 hours, which is the second largest day's fall upon our register, the heaviest having occurred on the 10th July, 1889 (2.57 ins.). There were also falls of rain of about half-an-inch each on the 18th, 26th, 27th and 29th. The month's total rainfall (5.37 ins.) was greater than in any July since 1879, and it is the more remarkable when it is remembered that all except a quarter of an inch fell between the 18th and 30th; in other words, about double the month's normal rainfall fell in half the month.

August.

This month was more remarkable for its absence of really warm summer days, and the prevalence of cloud and mist, rather than for its excessive rainfall, the latter being only .34 ins. above the average. The maximum temperature for the month was only 74 degrees, which is unusually low for August. Between the 13th and 27th the thermometer did not once touch 70 degrees. Much cloud prevailed at this time. The heaviest fall of rain on one day occurred on the 11th, when .65 ins. fell. This amount was small when compared to some other downpours during the summer, but it was followed by many days of lighter rains, which, coming just when the harvest was on the point of commencement and the holiday season was at its height, was exceedingly unfortunate. The first wheat was cut in this neighbourhood about the 15th, but it was quite the end of the month before harvest became general.

September.

An outburst of heat occurred simultaneously with the entry of September, with maxima of 80 degrees on the 1st, and 83 degrees on the 2nd. This was not destined, however, to last long, for after a sharp thunderstorm on the night of the 4th, the weather became broken up and cooler, culminating with a great barometric depression on the 10th and 11th. The mercury fell with unusual rapidity, from 29.93 ins. at 9 a.m. on the 10th to 28.82 ins. at 4 a.m. on the 11th, or 1.11 ins. in 19 hours. This disturbance was accompanied by violent wind and great downpour of rain, the

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amount of the latter registered here for the 24 hours ending 9 a.m. on the 11th being as much as 1.95 ins., or the second heaviest fall for the year. The latter part of the month was somewhat finer, but there were not many days together without rain. The total rainfall of the month was 1.22 ins. above the average, and that for the year to September 30th as much as 3.80 ins. above the mean.

October.

So rainy an October had not occurred since the abnormally wet one of 1892. Rain fell on 27 days, and, until the 28th, there were not two days together without rain. The total fall for the month was 4.21 ins., which was 1.31 ins. above the average, bringing up the year's excess to that period to 5.11 ins. The heaviest falls were .78 ins. on the 11th, and .57 on the 6th. The month was generally very cloudy and damp, but the mean temperature was 3.2 degrees above the average.

November.

Rain fell again nearly every day, although the falls were lighter than those of October, and, in the result, the month's total was only 1.87 ins. In the earlier part of the month fogs prevailed, and the air was constantly damp and stagnant. The frequent small falls of rain during the remainder of the month, and the great prevalence of cloud made the weather very uncomfortable on many days. The mean temperature was but little under normal, there being no unseasonably warm days or any very cold nights.

December.

The most remarkable feature of the weather of this month was the smallness of the diurnal range of the thermometer's readings. No temperature as high as 50 degrees was recorded, and on no occasion did the screened thermometer fall below 26 degrees. Some snow fell in the first week, but the quantity was very trifling, and until the 28th there was a constant succession of days of the same cloudy, damp, monotonous type that had so frequently prevailed throughout the autumn, indeed between September 1st and December 15th there were never more than two days together without rain. On some days the range of temperature between day and night was less than 2 degrees. Brisk east winds prevailed

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on the last four days of the month, and the dryness accompanying them formed an agreeable contrast to the previous humidity.

The Seasons.

The following tables give the mean temperature and rainfall of the four seasons, together with those of the five previous years, compared, as to temperature, with the average of the twenty years 1883—1902, and as to rainfall, with the 38-year average, 1865—1902, mentioned in last year's notes. Winter comprises the three months, December to February inclusive; Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1898.	1899.	1900.	1901.	1902.	1903.	20-year average. 1883—02	Departure of 1903 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	41.3	42.6	37.4	39.0	37.9	41.8	38.0	+ 3.8
Spring ...	45.8	46.2	45.3	46.3	46.3	47.3	46.3	+ 1.0
Summer ...	59.7	61.9	61.6	61.4	58.7	58.7	60.3	— 1.6
Autumn ...	54.0	51.2	51.6	50.7	50.1	51.2	50.2	+ 1.0
Year	50.5	49.8	49.6	48.8	48.4	49.5	48.7	+ 0.8

RAINFALL.

Seasons.	1898.	1899.	1900.	1901.	1902.	1903.	38-year average. 1865—02	Departure of 1903 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	4.11	5.82	7.42	5.88	6.09	3.64	5.96	—2.32
Spring ...	6.18	6.84	4.26	5.10	6.77	5.83	5.27	+ 0.56
Summer ...	6.90	3.52	8.77	3.61	7.82	10.54	6.94	+ 3.60
Autumn ...	5.65	8.31	5.32	5.11	4.14	9.77	8.01	+ 1.76
Year ...	23.33	23.94	26.99	21.06	22.30	29.44	26.18	+ 3.26

The most conspicuous variation from the normal, with regard to temperature, was the winter, which was 3.8 degrees above the average. Spring and autumn were each one degree warmer than usual, while the summer, like the previous one, was 1.6 degrees below the standard. The winter's rainfall was 2.32 ins. deficient, the spring, summer and autumn each in excess, the greatest overplus occurring during the summer months, when the fall was 3.60 above the mean, and was the highest summer rainfall since 1880, when the total at Norwich was 10.84 ins. In 1879, however, it was 13.95 ins., or 3.41 ins. more than in 1903.

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The Year.

The year 1903 was altogether a very disappointing one as regards weather. The balmy breezes of February and March, resulting as they did in such a wealth of flowers and blossoms as is but rarely seen before May, were followed by the cruelly cutting cold "snap" of mid-April, which ruined the fruit crop. Then, after a heavy downpour in the middle of June, which in itself would have done no harm, the fine four weeks which ensued, giving promise as they did of a very genial summer, were suddenly followed by the tropical torrents of the second half of July. Again hopes for finer weather in the middle of August were cut short by further rain, just as harvest was commencing, and the hot days with which September entered were followed, as above stated, by a period of three and a half months, during which there were never more than two dry days at a time. The general dampness and gloominess of the last weeks of the year made the weather of this season appear wetter than the results of the rain gauge disclosed, as in fact, November and December yielded somewhat less rain than the average. The total rainfall for the year, as recorded here, was 29.44 ins., falling on 208 days. This total is the highest since 1892, when the amount was 31.05 ins. The number of days with rain was surpassed, as lately as 1900, when rain occurred on 222 days. The inequality of the distribution of rain during the year over the county of Norfolk is very remarkable. At Hillington the total fall was no less than 35.64 ins., whereas at Ormesby, on the other side of the county, it was only 24.46 ins. At Yarmouth it was an inch below the average. The western side of the county was generally much wetter than the eastern, and passing out of the county further to the west, we find that in Hertfordshire the fall was greater still, and at Haverfordwest it exceeded 50 ins. The summer falls in the Thames Valley were very notable, and it is also remarkable that whereas in the vicinity of London there were frequent thunderstorms of great violence during the year, in Norfolk but little thunder accompanied our heaviest summer rains. Altogether the year was a disastrous one to agriculture generally, and will not readily be forgotten.

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1903.

Month.	Barometer. Highest.	Date.	Lowest.	Date.	Mean.	Thermometer. Highest.	Date.	Lowest.	Date.	Mean.	Hygrometer. Mean Relative Humidity, 9 a.m.	Cloud. Estimated proportion	Rainfall. Inches.	No. of days.	Wind. Direction. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W	Mean estimated force
Jan. .	30.63	14	29.25	7	29.976	54.8°	26	27.5°	14	40.6°	88	7.3	1.68	17	0	2	2	6	3	8	8	2	4.1
Feb. .	30.65	17	29.30	1	30.088	58 6	9	24.8	17	44.3	87	6.6	0.34	8	2	1	0	0	1	10	10	4	4.2
March	30.36	8	28.73	2	29.836	64.6	25	28.2	12	45.6	85	6.5	1.73	19	3	0	0	1	11	7	7	2	4.2
April	30.34	10	29.35	29	29.853	60.0	29,30	28.6	20	43.5	76	7.4	2.52	22	4	3	1	1	3	3	5	10	3.8
May .	30.47	24	29.26	4	29.899	75 2	22	32.0	13	52.7	73	5.5	1.58	11	2	7	7	2	4	4	4	1	3.3
June .	30.42	5	29.63	15	30.052	86.0	28	34.8	13	56.0	73	6.4	2.45	10	5	7	5	4	4	1	1	3	3.1
July .	30.34	9	29.52	28	29.914	83.2	10	40 4	21	60.7	74	6.3	5.37	19	5	0	0	2	1	3	13	7	3.0
Aug. .	30.20	26	29.22	15	29.829	74.0	13	44.4	22	59.3	77	6.3	2.72	17	1	0	1	1	6	5	12	5	3.7
Sept. .	30.41	15	29.21	10	30.022	83.0	2	38.2	18	57.8	84	5.3	3.69	20	4	0	5	3	2	5	6	5	3.0
Oct. .	30.06	19	28.99	12	29 647	67.0	3	35.4	24	52.5	88	7.6	4.21	27	1	0	0	0	9	6	13	2	3.9
Nov. .	30.60	6	29.01	28	30.006	56.0	2	28.2	7	43.3	90	6.9	1.87	28	4	3	0	0	3	2	8	10	3.0
Dec. .	30.30	21	29.16	10	29.782	49.0	14	26.0	5	37.8	90	7.8	1.28	15	4	1	8	5	9	2	0	2	3.9
Means					29.909					49.5	82	6.7											3.5
Extreme & Totals	30 65	Feb. 17th	28.73	Mar. 2nd		86.0	June 28th	24.8	Feb. 17th				29.44	208	35	24	29	25	56	56	87	53	

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XIII.

ON *CAREX PARADOXA* AND *LASTREA CRISTATA* IN BRITAIN.

By Arthur Bennett, F.L.S.

Read 23rd February, 1904.

For many years one York locality, and the one Irish one, were the only ones known for the *Carex*. It had been passed over as *teretinscula* by good English botanists, until Mr. Borrer identified it with the continental species; and in 1852 Mr. H. C. Watson had only one county to record it from in his 'Cybele Britannica,' vol. iii. 108. From *paniculata* and *teretinscula* it can be at once identified by the large number of frayed sheaths at the base of the stem; unfortunately this character is not shown in the English Botany plate, Supp. 2899 (t. 1621 of the 3rd edition).

Carex paradoxa. Willd., in Act. Acad. Berol, t. i, fig. 1, p. 39, 1794.

C. paniculata. L., sub-sp. *C. paradoxa*, Willd., Hook. Stud. Flora, ed. iii., 450, 1884.

So far as I know there is no real English name for this *Carex*.

Distribution:—

Norway, Sweden, Denmark, Finland—centre and south, Germany, Holland, Belgium, France, N. Italy, Austria, Hungary, Croatia, Serbia, Russia—middle and west, Switzerland.

In England:—

20. Herts.

"It grows also in the contiguous meadows in Herts." J. of Botany, 339, 1885.

Uxbridge marshes, sp.

21. Middlesex.

Canal near W. Drayton, 1872. Hon. L. Warren. J. Bot. 380, 1873.

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Extremely abundant in the moors below Springwell Lock; in meadows between Denham Lock and Harefield Moor, and not infrequent by the sides of ditches and canals from Denham Lock to the boundary. J. Bot., 339, 1885.

26. SUFFOLK W.

Near Icklingham St. James, in a bog between the river and the road from Mildenhall. May, 1872. Marshall, sp.

Market Weston Fen. Herb., Gray. Fl. Suff., 374, 1889.

27. NORFOLK E.

Bogs at Hoveton. Babington Man., ed. 4, 367, 1856. Linton, sp., 1882. Abundant at Ranworth, June, 1884, Hanbury and Bennett; here the species grows with a small f. of *C. Hudsonii* (*stricta*) and *Liparis Loeselii* half shaded by Willows, etc. Ward Marsh near Thurne, J. and A. Bennett, 1903. Upton, Geldart, 16, 7, 1886 (Trans. Norf. and Nor. Nat. Soc. vol. iv. 258, 1886). Hickling, without collector's name. Wood Marsh, Stalham; Great Fen between Catfield and Barton Broad, C. E. Salmon, sp. 1902.

29. CAMBRIDGE.

Wicken Fen, abundant. A. Fryer, sp., 18, 6, 1885.

57. DERBY.

Near Shirley Mill. G. E. Smith, M. S. Painter, Fl. Derby, 125, 1889. Rev. W. R. Linton does not accept this. Fl. Derby, 296, 1903.

61. YORK S.E.

Heslington Field near York, April, 1841, but not identified till September, 1843, by Mr. Borrer. W. Middleton, 1830, in herb York (as *teretinscula*). S. Thompson, 1844. Extinct, Fl. E. Riding, 200, 1902. Near Beverley, 1796, R. Teesdale in York. Phil. Soc. Herb sp., as *teretinscula*.

64. YORK M.W.

Askham Bog. R. Spruce, 1842? in 1871! 1881! and 1884! Gathered here as *C. teretinscula* by J. Backhouse in 1818.

In a Carr between Healaugh and Askham Richard. L. C. Miall Baker, Supp. Fl. York. H. Ibbotson, 1850, herb., York; J. G. Baker, in herb. Watson!

IRELAND.

Plentiful in a boggy wood at Ladiston on the shore of Belvedere Lake (Lough Ennel) near Mullinger. Moore.

"Only a few plants left at Ladiston. In the Bog of Linn, and

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sparingly in the 'Scraw Bog, Loughanston. Levinge, 1891, sp. 1894. Cyle. Hib. ed. 2, 395, 1898."

Tullaghan Bog near Loch Ewel, Westmeath. E. S. Marshall, J. Bot. 272, 1899.

To show how remarkably the distribution of this plant has been extended in Britain lately, it is only needful to quote Mr. Baker's N. Yorkshire, 394, October, 1892, when he gives it from two localities in that V. county, and adds, "There is only one other strictly British locality, and one in Ireland." We have now four localities in Ireland, and twenty-three in Britain, distributed through eight counties.

I have not seen any British specimens in the reduced form, *β sparsiflora*, Lange, Hand. Danske. Fl., 122, 1886.

For an interesting discussion on this species, *C. teretinscula*, and *C. paniculata*, see 'Phytologist,' 842, 895, 918, 1021, 1119, 1122 in 1843—4.

First record. Babington. Man. Brit. Bot., ed. 1, 337, 1843.

LASTREA CRISTATA. Presl. Pteridogr., 77, 1836.

ASPIDIUM CRISTATUM. Swartz, Syn. Fl., p. 52.

LOPHODIUM CALLIPTERIS. Newman, Hist. Brit. Ferns, 170, 1854.

POLYPODIUM CRISTATUM. L., Sp. pl., 1090, 1753.

CRESTED SHIELDFERN; Crested Fern.

Distribution:—

Denmark, Norway, Sweden, Finland, Germany, Holland, Belgium, France, Switzerland, Tyrol, Hungary, Croatia, Transylvania, Russia. Indicated in Spain.

America, U.S.A., South to Arkansas and Kentucky; Canada, Newfoundland to Manitoba. Asia, W. Siberia.

England:—

25. SUFFOLK E.

Fritton Decoy. Wigham, 1837. Herb. Skepper.

Westleton Decoy. M. S. Davey, Smith Eng. Fl. 4, 289, 1828. Edge of Westleton Moor. F. Spalding, Fl. Suff., 418, 1889.

Bexley Decoy, near Ipswich. Sp. Ipswich Museum. 'Phytologist,' Bidwell and Haward.

27. NORFOLK E.

In the Marsh near the Ferry, Surlingham, September, 1850. Rev. W. S. Hore. Bot. Gaz. ii., 277, 1850.

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Wymondham. Syme, Eng. Bot., ed. 3, 12, 72, 1886.

Hickling. Mr. Evans, sp.

In the parish of Horsey and its borders in abundance. Mr. Cotton, 1890. Here the plant occurs in great abundance in all stages of growth, 1900! 1902!

Heigham Sounds, near Burnley Hall. A. O. Black. Syme, *l.c.* Some error of description, as Burnley Hall is in E. Somerton.

"Sent from the Lows on Holt Heath in 1805 by Rev. R. B. Francis, where it was growing among furze-bushes by the side of a drain." Smith, Eng. Fl. iv., 289, 1828.

Sought at Holt and Edgefield by Mr. Geldart in vain since 1880. "Nearly exterminated in Norfolk by the Fern dealers." O. Corder to J. S. Gibson, 2, 8, 1868. Note in Rev. Newbould's copy of Trimmer's Flora.

28. NORFOLK W.

"Bawsey, near Lynn, intermixed with the common Ling, and is shaded by a few young Alder trees." Newman, Brit. Ferns, 172, 1854. Rev. G. Mundford, sp. 1840. Cross, sp., 1880.

Edgefield. Mr. Wigham. W. Bean, sp. 1852. Mr. Wilkinson, Dersingham, Mr. W. Burlingham. Scoulton Mere, Plowright, 29, 6, 1873, T ans. Soc. 2, 131, 1874–9. Hanbury sp., 20, 7, 1883.

Fakenham. Syme *l.c.*

31. HUNTS.

Huntingdon. Rev. M. J. Berkeley. Watson, Top. Bot. ed. 1, 494, 1874. Probably in the neighbourhood of Whittlesea Mere, *i.e.*, near Holme Lode. "The author saw a plant from Holme Fen, in its neighbourhood cultivated by Mr. Henderson, at Milton Hall." A. Irvine, London Fl. 81, 1838.

39. STAFFORD.

Madely Bog near Newcastle-under-Lyne. Syme *l.c.*

Swampy ground, Kingston Pool, near Stafford. "A fine large rootstock with about thirty fronds. Aug. 21. 1885." Dr. Fraser in Bot. Record Club, Rep. 137, 1884-6 (1887).

Chartley Moss. Rep. N. Staff. N. H. Soc., 1886.

The second and third localities are now drained, or nearly so. Bagnell, Fl. Staff., 67, 1901.

56. NOTTS.

Oxton Bogs. Dr. G. Howitt, circa 1839. W. Ainley, 14, 9, 1841. J. Lucas, sp., 1858. H. Fisher, 10, 8, 1898! Wilkinson, sp.

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Oxton Bogs. Dr. J. Perry, F.R.S., 1837—8.

Many specimens were distributed by Mr. C. Melvill from Dr. Perry's herbarium. Exch. Club, Rep. 505, 1895 (1898).

58. CHESTER.

Wybunbury Moss. Rev. G. Pinder, Phyt., 1, 481, 1843. Dr. Wood, sp., 10, 8, 1847. W. R. Ranson, October, 1850. Dr. Fraser, sp., 10, 8, 1875. S. Thompson, 1855, herb., Whitwell. C. Melvill, 1884.

Achmere. J. F. Robinson, Bot. Ex. Club, Rep. 1871. p. 21 (1872).

Hatchmere, extinct. Egerton in Tabley's Fl. Cheshire, 371, 1899.

61. YORK S.E.

Kennythorpe Moor. Messrs. Monckton and Mackle. "First found by the latter." Mr. M. Slater in litt. This is the locality reported as "Near Malton" in Lowe's 'British Ferns.'

"Probably also in Cliff Wood." J. J. Marshall in Flora, E. Riding, 221, 1902.

63. YORK S.W.

Thorne Waste. W. Casson (1856), Herb. Backhouse. Still there in 1872. Lees' Fl. W. Yorkshire, 510, 1888.

64. YORK M.W.

Askham Bogs, south end. Thornton, 1873. R. M. Christy and J. W. West, 1875—1877. D. and A. Ellis, October, 1878. Wilkinson, sp., 1893. "Mr. Backhouse found about fifteen specimens in all." Ibbotson, 'Ferns of York,' p. 12, 1884.

74. RENFREW.

"On the edge of a Loch beyond Crofthead near Neilston, twelve miles S.W. of Glasgow. First discovered by Dr. W. Arnott and Mr. Clarke, Curator of the Glasgow Bot. Garden." W. Galt, in Watson's Comp. Cyb. Brit., 615, 1870! Mr. Somerville was unable to find it here, "Loch Libo," in September, 1903.

Reported also in Devon, Wilts, Surrey, Oxford, Bedford, Worcester, Linlithgow, Aberdeen.

9. DORSET.

Mr. Mansell-Pleydall in Fl. Dorset, ed. 2, 329, 1895, gives six stations for this species, but there is great doubt whether in any one of the localities it is the true plant. One of the localities has been carefully searched by five botanists without success.

In the station near Horsey this species grows in great abundance,

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so much so it is impossible to walk in the marsh without crushing the fronds; there are thousands of specimens, from minute plants, one to two inches high, to others two feet six inches. In some parts the ground is very wet, in June often having two to twelve inches of water on it, *Cladium* occurring in great beds, with *Schœnus nigricans*.

In most counties this species is becoming very rare; it has been sought in vain in recent years in Suffolk; almost (quite?) extinct in Stafford. I know of no recent record in Notts; in Chester a few specimens may remain; even if extant in Yorkshire, it is yearly decreasing. In all other stations it is nearly gone, and probably the only place where it is in any abundance is in E. Norfolk.

In the original edition of 'English Botany,' *Lastrea-filix-mas* was figured for *cristata* on plate 1949; the true plant being on plate 2125, reproduced by Syme as t. 1853, but it is not a good figure.

The plant called *L. uliginosa*, Newman has been variously estimated as a species, a variety, and a hybrid. Some have regarded *cristata*, *uliginosa*, and *spinulosa* as one species, connected together by a series of intermediates. So far as *spinulosa* and *cristata* is concerned, I carefully sought in the Horsey station for any specimens that I could not refer to *cristata* at a glance, but I could find none. But *spinulosa* there does shade off in forms that it is very difficult to assign to or separate from *uliginosa*.

At Horsey I examined hundreds of specimens of *cristata*, but I could find no appreciable difference, except what one would expect from some being in wetter places than others.

The best distinction between *uliginosa* and *spinulosa* seems to me to be in the former having the whole frond and pinnæ curving upwards, the less cut pinnæ, and the whole frond being stiffer and more rigid looking.

Where *cristata* grows alone, there seems to be no *uliginosa*. If these three plants are one species why does not *cristata* vary in itself towards *spinulosa*? While it is difficult to assign some specimens between *uliginosa* and *spinulosa*, it is never so between *cristata* and *spinulosa*.

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XIV.

A SHORT TRIP TO SPAIN, WITH NOTES ON BIRDS OBSERVED.

By Mr. Charles A. Hamond.

Read 23rd February, 1904.

I must beg the indulgence of my hearers this evening for these very scanty Natural History notes. July is not a very good time for observing birds, many species are in the moult and the young birds not in full feather. It is also very difficult to identify many of the smaller birds, unless one can handle them, especially if it is one's first sight of them out of a museum.

I was fortunate in my companions who are both keen sighted, and my son had been in the Mediterranean for a year and was acquainted with many species that were new to me.

I have only mentioned those birds that I made sure of. Mr. Musters, of Annesley Park, Nottinghamshire, who has a magnificent collection of birds on the British list, many of them procured in Spain, helped me with some that I was doubtful about. My chapter on the wild animals of Spain will compare with Holbrow's celebrated chapter on Snakes in Iceland. There are no wild animals in Spain, or at least I didn't see any, though my son picked up the skull of a fox on the hills at Granada.

My son, who was then a midshipman in H.M.S. "London," wrote that he could get a fortnight's leave in July when the fleet was at Gibraltar, and that we had better come out and spend it with him; so, like dutiful parents, my wife and I landed at Gibraltar on July 14th and crossed at once to Algeciras, where there is a beautiful hotel built in the Spanish fashion, with a big patio in the centre, marble-floored, and Swallows' or Martins' nests on every coign of vantage. The manageress whose grandfather had been a farmer at

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Bintry, our next parish, naturally gave us a warm welcome. Algeciras town had few attractions beyond a multitude of Swifts, swarming like Bees round the towers, a Whimbrel on the rocks, and some Skuas Sp.? in the bay. In a short walk that evening I saw a Viperine Snake in a pool apparently catching small fish, and some Black-headed Warblers. The fleet we found was not due for a week, and a gentleman who was going up to see after mines at Seville, advised us to go up to Cordova, Seville and Cadiz, so the next morning we started early by train. The line winds up through a succession of rough limestone gorges, the country being very much burnt up and brown, except where the course of streams was marked in pink by Oleanders. I noticed Hoopoes, Red-legged Partridges, Crested Larks, and a variety of birds of prey which I could not identify. The heat was not oppressive; our friend, the mining engineer, Mr. Starkey, was most kind, and we had the advantage of his intimate knowledge of the country and language. The harvest almost entirely of bearded wheat was lying unprotected in sheaves or being carted to thrashing floors where the peasants were driving round troops of mares on the corn to tread the grain out, in fact, the Spanish peasant whom we expected to find taking the national siesta, seemed to work through the heat of the day with as much energy as if he were harvesting in Norfolk. At Cordova, the glorious mosque claimed our attention for some hours, and towards sunset we sat in a balcony overlooking the noble bridge, built by Romans, repaired by Moors, and neglected by Spaniards, which crosses the broad bed of the Guadalquiver. There were many Lesser Kestrels hawking for flies or beetles round the mosque.

By rail to Seville over the wide plain of the Guadalquiver were many Shrikes, Goldfinches, and smaller Finches, which I believe were Serin Finches, for I saw many later. I first noticed Egyptian Vultures here, and Woodchat Shrikes on the telegraph wires. At Seville there were many Storks on the towers; we spent some time in the cathedral and ascended the Giralda, whence we had a splendid view of Seville and the surrounding country; there were here also many Lesser Kestrels which seem to be as "temple-haunting" in Spain as Jackdaws are in England. The bell-ringer in the tower had Red-legged Partridges in a cage; these are commonly kept in Spain as call birds to lure their wild relatives

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into gunshot. I failed to find a naturalist's shop or a museum of natural history, and caged birds were generally Goldfinches or Quail. To Cadiz by rail, a most interesting journey, for the latter part is through a marshy plain, where I saw Pratincoles, Lesser Egrets, Buff-backed Herons among the cattle, and Redshanks. Between Zerey and Cadiz are extensive salt marshes, cut out into pans for evaporating the salt, huge mounds of which glitter like snow in the sun. There were numbers of Stilts here and other undistinguishable Waders. I longed to be able to see more of that marsh.

At Cadiz, surrounded on three sides by sea, I noticed nothing in the bird line but Terns at a distance, species unknown.

Returning by sea to Algeciras we found the fleet in, and our son at the hotel; his one idea was to get into the country, so we started for Granada by the same line of rail as far as Bobadilla, whence we branched off to Granada. After endless miles of yellow plain and monotonous olive groves, we traversed the green fertile Vega, irrigated by the snow-fed streams from the Sierra Nevada. We stayed in a hotel at the Alhambra, high above the city, and devoted our mornings to the Moorish palaces and forts. Hundreds of Swifts frequent the towers and were especially noticeable nesting in the fine tracery of the beautiful Court of the Lions, in fact, to my son they were the principal attraction of the Alhambra, though he noticed Blackcaps, Black-headed Warblers and Pied Flycatchers in the gardens. Washington Irving, in his delightful 'Tales of the Alhambra,' mentions a long lean fellow whom he observed manœuvring two or three fishing rods from the top of one of the towers, he was amusing himself with catching "Swallows and Martlets" with hooks baited with flies. Our afternoon walks were generally taken among the rough hills behind the Alhambra, "The Silla del Moro" or Seat of the Moor; here we met with our first Blackchat, a bird that puzzled us for some time, a nest of Woodchat Shrike with young, nearly fledged, in an olive tree close to a house, Redlegged Partridges, Crested, Short-toed and Calandra Larks, a Kite, Ocellated Lizards, a big Snake which escaped us, Swallow-tail Butterfly laying eggs on Fennel, scarce Swallow-tails in poor condition, Bath White, Heath Fritillary, *Meletæa athalia*, Tailed Blue, and many of our common English Butterflies. The flowers on the hill-side must have been a lovely sight three

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months earlier, but were of course gone to seed. I found a variety of small Antirrhinums, Larkspurs, Gum Cistus, Scabious and many species of Thistle and Eryngium, all prickly in the extreme: we pitied the traditional Moor who made that hillside his seat, for if one were lucky enough to find a flat stone among the prickles, the Ants soon gave one notice to quit. But the sunsets looking over the towers of the Alhambra, the city of Granada lying below, and the Vega beyond, stretching to a rugged range in the west, were worth a little discomfort to see.

A ride across the Vega on a blazing afternoon introduced us to the Rufous Warbler; the first we saw attracted our attention by his song, as few birds sing in July. They were numerous, dusting themselves in the roads, spreading their tails out like fans, and so tame as only just to flutter out of our horses' way. Southern Shrikes, Woodchats and Black-headed Warblers were common. On a long ride up the valley of the Zenil, Common and Sand Martins and Crag Martins, the flight of the latter is very marked and drew our attention to it. It has a habit of rising and falling with a swoop almost like Wood-pigeon's play in the breeding season.

The high range of the Sierra Nevada walled in the valley in front of us, rising to 11,000 feet. I wished for time and opportunity to explore the mountains, as masses of snow were visible from this valley. In this neighbourhood, the Lammergeier or Bearded Vulture nests, as well as the Neophron or Egyptian Vulture and the Griffon. I killed a small Snake in the olive grove where we lunched, which I believe was a Viperine Snake; it had no poison fangs. A kind of Brimstone Butterfly was plentiful here, with very beautiful orange upper wings, which my son told me was *Gonopteryx cleopatra*. Also *Satyrus actæa* and *Satyrus circe*.

We were sorry to leave the Alhambra, which is not much frequented by visitors in summer. Two pleasant American artists were staying in the hotel, and a few Sevillians who had come up to escape the great heat. Our return journey was on the hottest day we experienced in Spain; we waited at the junction at Bobadilla for five hours for the afternoon train, and made ourselves comfortable in the large cool refreshment room. My son and I walked out across the plain to a grove of trees surrounding a farmhouse about a mile off, and were rewarded for a hot walk by a good sight of an Egyptian Vulture. There had been a doubt cast upon

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my identification of Hoopoes by my very critical midshipman, but on this memorable evening, our railway carriage full of dozing Spaniards was roused by a sudden shout from us both "There's a Hoopoe," and a few minutes later we had a good view of a Bee-eater. The side windows of Spanish railway carriages open conveniently for observing birds.

There were a great many of the tiny Fantail Warblers in the grass and bushes near Algeciras, and even in the hotel garden. Our son rejoined the "London," and we had a view of twelve huge battleships moving out in line on their way to Lagos for the Atlantic manœuvres.

One day my wife and I walked up to the signal station at the top of the Rock of Gibraltar and saw a curious effect of glimpses of the Mediterranean, Spain, and Africa through rifts in the stream of cloud accompanying the Levanter, and also a fine view of some handsome Blackchats, which were sitting on the steep cliff facing the Mediterranean.

On our last evening in Spain we drove towards Tarifa, sketched the Straits and African coast, and noticed no less than thirty Lesser Kestrels sitting on the telegraph wires in a flock, probably gorged with the numbers of Crickets and Locusts which rose like small birds at every step one took off the road.

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XV.

THE COLEOPTERA OF NORFOLK AND SUFFOLK

By Claude Morley, F.E.S., etc.

Read 29th March, 1904.

The fact is often deplored by the student of geographical distribution that, while he is able to collect plenty of general and far-ranging data, the details of his scheme are wanting or but little apparent; that it is easy to account for the presence of a certain animal only on a mountain top, whose place is entirely filled by another, though usually allied, animal in the adjoining valley, but very difficult to tell what influences determine the gradations of range of those kinds inhabiting the intermediate zone. Both Norfolk and Suffolk are so fortunate as to have their insect—and especially their coleopterous—fauna fully investigated; it is, of course, impossible to say when a district list is complete, and probably so happy a state must always be impossible for a variety of obvious reasons, but these have been worked very thoroughly in comparison with the majority of the English counties. Consequently we have a capital basis upon which to work out the distribution of their Coleoptera, and it is much to be regretted that Cambridge and, I believe, Essex have never put forth efforts in the direction of county catalogues of their indigenous beetles.

The approximation and similarity of physical features, botany and geological formation of the sister counties, renders the comparison of their fauna particularly interesting. Norfolk has the advantage of more extensive broads and a longer seaboard, which is compensated to Suffolk by her greater extent of woodland and heath; on the west both dip jointly into the fen country and both run to the sea through the eastern broads. Where they join

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hands across the Waveney and Little Ouse it is often a matter of difficulty, and in some cases even speculation, to tell in which county the capture of a rare species was effected, nor, geographically, is it of great importance. Hence many Brandon Coleoptera are claimed by both; *Dytiscus circumflexus* at Burgh Castle rests in the Norfolk list, Curtis' record of *Ptinus lichenum* from "Thetford" in the Suffolk list, Garneys found *Monohammus sutor* "near Bungay," and Fowler occasionally mentions insects from "Ditchingham, Suffolk." Exclusiveness is, however, well to maintain when the exact locality is indicated, *e.g.*, Rev. William Kirby took *Homaloplia ruricola* at the Devil's Ditch at Newmarket in 1797, and Dr. Power *Chlænius holosericeus* at Isleham, which is in Cambridgeshire, but only half a mile over the border of Suffolk, whence neither is yet recorded, though both occur in Norfolk.

It cannot, of course, be supposed that every one of the old records—some of over a century ago—are entirely free from error; in the days before English text-books, or even from Stephens' unwieldy volumes, it was very difficult to correctly identify so extremely closely allied species as are to be found among our Coleoptera. Our *Carabus clathratus* is regarded by Mr. Newbery, than whom no one is more fitted to judge, as extremely doubtfully English, and he tells me he suspects *C. granulatus* was mistaken for it or that some other error gave rise to the record. *Anthrenus pimpinellæ*, *Cryptocephalus decemmaculatus*, and *Harpalus obscurus* have, perhaps, never really occurred in Suffolk, though the last is still found at the Devil's Ditch, a few miles over the western border; in like manner, Norfolk can hardly lay good claim to *Rhagium indagator* or *Coccinella quinquepunctata*, though *Rhinomacer attelaboides* has been found at Ipswich, and other well-known northern species have recently turned up, probably through the transportation of timber, so far south as the New Forest. Other kinds, such as *Astynomus ædilis*, *Gnorimus nobilis*, and *Carabus auratus*, are imported in a similar manner; and perhaps the lovely *Calosoma sycophanta* belongs to the same category.

We have also a few kinds which find no place in the British Catalogue, but which have reached our shores by various artificial agencies, and have not been included in the figures below. The Norfolk list shows three of these interlopers, and Mr. James Edwards, who has done so much good work in the

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elucidation of the insect-fauna, probably excluded others which came under his notice when compiling his very excellent catalogue of Coleoptera.* These are *Cardiophorus ruficollis*, *Cardiophorus thoracicus*, and *Gonioctena affinis*. The Suffolk list has six casual visitants, two within the last few years; these are *Licinus cassideus*, *Chlænius sulcicollis*, *Chrysomela carnifex*, *Chrysomela gloriosa*, *Oedemera podagrariæ*, and *Coryphocera elegans*.†

My own connection with Norfolk Coleoptera is but slight and intermittent, but, since additional localities and a widening range are always interesting, I may mention having found fifteen *Limnichus pygmæus* upon the Cromer cliffs in September, 1894; *Bythinus bulbifer* at Sheringham in 1903; *Apion ononidis*, commonly on *Trifolium*, on the Cromer cliffs; *Scolytus destructor* in Yarmouth in 1898; *Bryaxis sanguinea* at Roydon Fen in 1900; *Microglossa nidicola* in hundreds, in Sand-martins' nests at Thetford; *Scymnus capitatus* at Mousehold Heath (*cf.* Entom. Dec., 1901): a pupa of *Anomala Frischi* upon the Winterton sandhills; and *Galeruca nymphæ* in the flowers of *Nuphar lutea* at Horning. Some of the insects mentioned by Mr. E. G. Elliman (Ent. Rec. vii., p. 306) were not noticed in Mr. Edwards' supplement; of these *Ceuthorhynchus picitarsis* and *Bledius pallipes* are additions to our list, and he tells me that he also found *Apion pubescens*, *Colenis dentipes*, and perhaps *Thyamis membranacea* at Cromer in 1895. Richard Tyrer, of Eye, gives us another addition in *Mycetochares bipustulatus*, which he took (*cf.* Ent. Weekly Intelligencer) at Brockdish. None of these, nor the *Agrilus viridis* of the list, which is certainly *Agrilus angustulus*, Illig., are included in the following figures.

A certain number of species have been recorded for both Norfolk and Suffolk, and these I have omitted as common to both; the remainder of the records are of those kinds peculiar, as far as is at present known, to one or other of the sister counties, and the classified order is often sacrificed that members of the same genus may appear together.

* 'Fauna and Flora of Norfolk.' Part xii.: Coleoptera. By James Edwards, F.E.S.—Trans. Norf. Nat. Soc., 1893, pp. 427—508; 'Additions,' *lib. cit.*, 1899, pp. 515—527.

† 'The Coleoptera of Suffolk.' By Claude Morley, F.E.S., etc. Plymouth: J. H. Keys, Whimple Street, 3s. 6d. 1899.

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GEODEPHAGA.

Norfolk.	Suffolk.
Cicindela maritima	Cicindela hybrida
Notiophilus quadripunctatus	„ sylvatica
„ rufipes	Carabus auratus
Clivina collaris	Elaphrus uliginosus
Badister peltatus	Dyschirius salinus
Stenolophus vespertinus	„ impunctipennis
„ skrimshiranus	Panagaeus 4-pustulatus
Chlænius vestitus	Chlaenius nigricornis
„ holosericeus	Acupalpus exiguus
Bradycellus cognatus	Bradyellus distinctus
„ collaris	Dichirotrichus obsoletus
Harpalus melancholicus	Harpalus Frölichii
„ parallelus	„ obscurus
Pterostichus anthracinus	„ sabulicola
„ aterrimus	„ tenebrosus
„ lepidus	Pterostichus versicolor
Zabrus gibbus	Pristonychus complanatus
Amara infima	Amara consularis
„ rufocincta	Anchomenus piceus
Anchomenus livens	„ gracilipes
„ 6-punctatus	„ micans
Cillenus lateralis	Lymnaeum nigropiceum
Bembidium clarki	
„ anglicanum	Bembidium doris
„ ephippium	„ concinnum
„ fumigatum	„ gilvipes
„ lunatum	„ lunulatum
„ Stephensi	
„ stomoides	
„ testaceum	
Trechus micros	Trechus obtusus
„ rubens	Pogonus littoralis
Masoreus Wetterhali	
Aetophorus imperialis	Lionychus quadrillum
Dromius longiceps	Dromius sigma
„ quadrisignatus	Brachinus crepitans

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HYDRADEPHAGA.

Norfolk.	Suffolk.
Haliplus variegatus	Haliplus cinereus
Bidessus geminus	„ mucronatus
Deronectes 12-pustulatus	
Hydroporus lepidus	Hydroporus discretus
„ ferrugineus	„ bilineatus
„ neglectus	„ tristis
„ oblongus	
„ obscurus	
„ scalesianus	
Agabus striolatus	
„ uliginosus	
„ undatus	
Platambus maculatus	
Rhantus adspersus	
Dytiscus dimidiatus	Dytiscus circumcinctus
Gyrinus colymbus	
„ minutus	
„ suffriani	
Orectochilus villosus	

PALPICORNIA.

Hydrous caraboides	Hydrobius oblongus
Helocharis punctatus	Cercyon obsoletus
Laccobius minutus	
Limnebius picinus	Helophorus affinis
Helophorus brevicollis, Thoms.	„ brevipalpis
Hydrochus brevis	Ochthebius exaratus
„ carinatus	„ margipallens
Ochthebius rufomarginatus	Ochthebius punctatus
Hydraena gracilis	Hydraena testacea

BRACHELYTRA.

Aleochara ruficornis	Aleochara bipunctata
„ villosa	„ brevipennis
	„ cuniculorum
	„ lata

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Norfolk.	Suffolk.
	Aleochara fungivora
	„ obscurella
	Microglossa marginalis
Oxypoda formiceticola	Oxypoda annularis
Tachyporus pallidus	„ brachyptera
„ solutus	„ misella
„ transversalis	„ nigrina
Ocyusa maura	Ocyusa incrassata
Gymnusa brevicollis	Phloeopora corticalis
Hypocyptus discoideus	„ reptans
„ seminulum	Ilyobates forticornis
Calodera aethiops	„ propinqua
„ nigrita	Calodera umbrosa
Myrmedonia Haworthi	Myrmedonia funesta
Bolitobius exoletus	„ lugens
Mycetoporus longicornis	Callicerus rigidicornis
Alianta incana	Thamiaria cinnamomea
„ plumbea	Nototheca flavipes
Homalota atomaria	Homalota divisa
„ Aubei	„ elegantula
„ boletobia	„ fungivora
„ debilis	„ hepatica
„ elongatula	„ imbecilla
„ exilis	„ laticeps
„ fallax	„ liturata
„ fuscipes	„ luridipennis
„ gyllenhali	„ marcida
„ hodierna	„ mortuorum
„ hygrotopora	„ nigricornis
„ littorea	„ oblita
„ luteipes	„ occulta
„ montivagans	„ orphana
„ nigella	„ planifrons
„ perexigua	„ ravilla
„ puncticeps	„ sodalis
„ villosula	„ soror
Schistoglossa viduata	„ testudinea

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Norfolk.	Suffolk.
Tachyusa atra	Homalota triangulum
„ scitula	„ volans
„ umbratica	Baptolinus alternans
Xenusa sulcata	Xenusa uvida
Gyrophaena manca	Gyrophaena minima
Agaricochara laevicollis	Sipalia ruficollis
Placusa infima	Bolitochara bella
Silusa rubiginosa	„ lucida
Bolitochara obliqua	„ lunulata
Phytosus balticus	Xantholinus glaber
„ spinifer	Leptacinus formicetorum
Diglossa mersa	„ parumpunctatus
Myllaena dubia	Myllaena elongata
„ gracilis	Quedionuchus laevigatus
„ intermedia	Leistotrophus murinus
Tachinus collaris	Tachinus flavipes
„ laticollis	Vellius dilatatus
Heterothops praevia	Heterothops 4-punctula
Quedius microps	Quedius brevicornis
	„ brevis
Emus hirtus	„ fulgidus
	„ lateralis
	„ mesomelinus
	„ puncticollis
	„ scintillans
	„ scitus
	„ obliteratus
	„ nigrocaeruleus
	„ suturalis
Staphylinus pubescens	Staphylinus fulvipes
	„ latebricola
Ocypus pedator	Ocypus fuscatus
	„ similis
Philonthus agilis	Philonthus albipes
	„ atratus
	„ carbonarius
	„ fumigatus

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Norfolk.	Suffolk.
	Philonthus lepidus
	„ nigritulus
	„ proximus
	„ puella
	„ splendens
	„ ventralis
Lathrobium rufipenne	Lathrobium boreale
	„ filiforme
	„ longulum
	Achenium depressum
	Stilicus fragilis
	„ geniculatus
Scopaeus sulcicollis	Medon castanea
Sunius diversus	Sunius intermedius
	Paederus fuscipes
Stenus aerosus	Evaesthetus ruficapillus
„ carbonarius	Stenus ater
„ fuscipes	„ biguttatus
„ longitarsis	„ circularis
„ lustrator	„ crassus
„ opticus	„ declaratus
„ palustris	„ pallipes
„ proditor	„ subaeneus
Bledius fuscipes	Bledius arenarius
„ subterraneus	„ crassicollis
„ unicornis	Platystethus capito
	Oxytelus insecatus
	Trogophloeus arcuatus
	„ corticinus
	„ foveolatus
	„ halophilus
	„ rivularis
	Lestiva pubescens
Acidota crenata	Deliphrum tectum
	Coryphium angusticolle
Homalium riparium	Homalium exiguum
„ laeviusculum	„ iopterum

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Norfolk.	Suffolk.
	Homalium monilicorne
	,, oxyacanthae
	,, punctipenne
	,, salicis
	,, testaceum
	Hapalarea pygmaea
	Eusphalerum primulae
	Anthobium sorbi
	Phloeocharis subtillissima
Megarthrus hemipterus	Megarthrus affinis

CLAVICORNIA.

Pselaphus dresdensis	Batrisus venustus
Bythinus Burrelli	Bythinus securiger
,, validus	Trychonyx Maerkeli
Bryaxis haematica	Bibloporus bicolor
,, impressa	
Euplectus ambiguus	Euplectus signatus
,, Karsteni	Neuraphes rubicundus
Scydmaenus exilis	Scydmaenus pusillus
Euconnus fimetarius	Eutheia Schaumi
Calyptomerus dubius	Agathidium nigrinum
Clambus minutus	,, nigripenne
Liodes orbicularis	,, rotundatum
Cyrtusa minuta	,, varians
Anisotoma badia	Anisotoma cinnamomea
,, curta	Colenis dentipes
,, punctulata	Cryptophagus badius
,, rugosa	,, distinguendus
,, scita	,, pubescens
Necrophorus germanicus	,, punctipennis
,, interruptus	,, saginatus
Silpha reticulata	,, scanicus
Choleva anisotomoides	,, setulosus
,, coracina	,, umbratus
,, fusca	Choleva morio
Colon brunneum	,, nigrita

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Norfolk.	Suffolk.
Hister neglectus	Hister bissexstriatus
„ stercorarius	„ marginatus
Dendrophilus punctatus	„ succicola
Myrmetes piceus	Paromalus flavicornis
Gnathoncus punctulatus	
Saprinus metallicus	Anthrenus varius
Acritus minutus	„ pimpinellae
Ptinella denticollis	
Trichopteryx atomaria	Trichopteryx seminitens
„ bovina	
„ grandicollis	Nitidula flexuosa
„ guerini	Soronia punctatissima
„ Kirbyi	Symbiotes latus
„ Montandoni	Triplax aenea
Smicrus filicornis	Cyrtotriplax bipustulata
Nephanes Titan	Olibrus bicolor
Ptilium exaratum	Eustilbus atomarius
„ foveolatum	Carpophilus hemipterus
„ marginatum	Aglenus brunneus
Nossidium pilosellum	Ptenidium fuscicorne
Ptenidium Kraatzi	„ laevigatum
„ nitidum	„ Wankowiezii
Orthoperus Kluki	Orthoperus atomarius
Sericoderus lateralis	Alexia pilifera
Coccinella 5-punctata	Hippodamia 13-punctata
Scymnus testaceus	Scymnus nigrinus
„ haemorrhoidalis	„ pygmaeus
Ips quadripustulata	„ pulchellus
Epurea florea	Epurea melina
„ decemguttata	„ melanocephala
„ oblonga	„ obsoleta
Meligethes bidens	Meligethes erythropus
„ coracinus	„ pedicularius
„ fulvipes	„ umbrosus
Synchita juglandis	Tenebriodes mauritanica
Cerylon ferrugineum	Cerylon histeroides
Rhizophagus dispar	Rhizophagus ferrugineus

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Norfolk.	Suffolk.
Pediacus dermestoides	Rhizophagus perforatus
Laemophlaeus ater	
Nausibius dentatus	
Silvanus surinamensis	
Monotoma rufa	Monotoma longicollis
„ brevicollis	Melanophthalma fulvipes
„ quadricollis	„ similata
Holoparamecus depressus	Anommatus 12-striatus
Lathridius testaceus	Lathridius elongatus
Corticaria fulva	Corticaria serrata
Telmatophilus typhae	Ephistemus gyrinoides
„ Schönherri	Triphyllus suturalis
„ sparaganii	Mycetophagus 4-guttatus
Paramecosoma melanocephala	„ atomarius
Atomaria barani	Atomaria peltata
„ elongatula	„ berolinensis
„ rhenana	„ nigripennis
Dermestes undulatus	Dermestes vulpinus
Georyssus pygmaeus	
Elmis Volkmari	
Limnius troglodytes	Trinodes hirtus
Parnus algiricus	
Heterocerus flexuosus	Heterocerus fusculus
„ marginatus	„ obsoletus

LAMELLICORNIA.

Aphodius plagiatus	Aphodius constans
	Plagionus arenarius
	Diastictus vulneratus
Heptaulicus sus	Heptaulicus villosus
Homaloplia ruricola	Geotrupes pyrenaeus
Gnorimus nobilis	Copris lunaris

STERNOXI.

Trachys minuta	Aphanisticus pusillus
Microrrhagus pygmaeus	
Corymbites castaneus	Elater lythropterus
„ cupreus	Ludius ferrugineus

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MALACODERMA.

Norfolk.	Suffolk.
Prionocyphon serricornis	Helodes marginata
Eubria palustris	
Malthodes nigellus	Malthodes atomus
„ flavoguttatus	„ fibulatus
Anthonomus terminatus	Phloeophilus Edwardsi
Trichodes apiarius	Necrobia rufipes

TEREDILIA.

Bostrychus capucinus	Ptinus 6-punctatus
	Niptus crenatus
Anobium panaceum	Anobium fulvicorne
	Rhizopertha pusilla
Lyctus canaliculatus	Lyctus brunneus
	Sphindus dubius
Cis festivus	Cis fuscatus
	„ hispidus
	„ vestitus
	„ villosulus
	Rhopalodontus fronticornis
Aspidiphorus orbiculatus	Ennearthron cornutum

LONGICORNIA.*

Rhagium indagator	Hylotrupes bajulus
Pogonocherus fasciculatus	Callidium alni
Monohammus sartor	Clytus mysticus
Agapanthia lineatocollis	Grammoptera analis
Oberea oculata	Mesosa nubila

PHYTOPHAGA.

Donacia crassipes	Bruchus pectinicornis
	„ affinis

* I think *Leptura sanguinolenta* should be omitted from both the Norfolk and Suffolk lists; the records are most unsatisfactory and no authentic British specimen is known to exist!

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Norfolk.	Suffolk.
Cryptocephalus coryli	Cryptocephalus parvulus
,, bilineatus	,, 10-maculatus
,, moraei	,, 6-punctatus
Chrysomela Banksi	Zeugophora flavicollis
,, menthastri	Plagiodera armoraciae
Galeruca nympheae	Thyamis agilis
,, calmariensis	,, atriceps
,, viburni	,, dorsalis
Thyamis rutilus *	,, ferrugineus
	,, lycopi
	,, teucrii
	,, picipes
	,, suturellus
	,, suturalis
	,, Waterhousei
	Haltica pusilla
Apteropeda globosa	Aphthona herbigrada
,, splendida	Mantura chrysanthemi
Crepidodera ventralis	Crepidodera helxines
	,, smaragdina
Plectroscelis Sahlbergi *	Epitrix pubescens
Psylliodes hyoscyami	Psylliodes attenuata
	,, cyanoptera
Cassida nebulosa	Cassida hemisphaerica

HETEROMERA.

Phaleria cadaverina	Blaps similis
Tenebrio obscurus	Opatrum sabulosum
	Diaperis boleti
	Helops pallidus
	Cistela ceramboides
	Mycetocharis bipustulatus

* No doubt is indicated concerning the occurrence of *P. Sahlbergi* in the Norfolk list; I simply draw attention to the fact, since the species is so rare and appears to find its headquarters in Ireland. In like manner, *T. rutilus* is confined to the South coast of England, and one suspects the Norfolk specimens to be the red form of *T. jacobeae*.

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Norfolk.	Suffolk.
Elenchus tenuicornis	Halictophagus curtisi
	Tetratoma ancorae
Salpingus aeratus	Osphya bipunctata
	Mordella fasciata
Mordellistena inaequalis	Mordellistena abdominalis
	„ humeralis
	„ lateralis
	Anaspis Costae
	„ Garneysi
	„ latipalpis
	Anthicus humilis
	„ instabilis

RHYNCHOPHORA.

Brachytarsus fasciatus	Rhinomacer attelaboides
Anthribus albinus	Rhynchites Bacchus
Platyrrhinus latirostris	„ pauxillus
Tropideres albirostris	„ sericeus
„ niveirostris	„ megacephalus
Apion ononidis	Apion affine
„ craccae	„ assimile
„ curtisi	„ astragali
„ meliloti	„ cruentatum
„ scutellare	„ dissimile
	„ filirostre
Procas armillatus	„ fuscirostre
	„ genistae
	„ laevigatum
Smicronyx jungermanniae	„ pubescens
	„ sanguineum
Trachyphloeus aristatus	„ sedi
„ squamulatus	„ sorbi
Caenopsis fissirostris	„ stolidum
Strophosomus retusus	„ unicolor
	„ vicinum
Otiorhynchus muscorum	Otiorhynchus atroapterus
	„ ligneus
Erirhinus bimaculatus	„ tenebricosus

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Norfolk.	Suffolk.
	Exomias brunnipes
Tropiphorus carinatus	Tropiphorus tomentosus
Barypeithes sulcifrons	Phyllobius calcaratus
Polydrusus chrysomela	Sitones ononidis
Hypera arundinis *	Hypera murinus
„ suspiciosa	„ rumicis
Pissodes notatus	„ trilineata
Dorytomus agnathus	Dorytomus validirostris
„ hirtipennis	Anoplus roboris
„ costirostris	Gymnetron collinus
„ salicinus	Mecinus circulatus
Bagous binodulosus	Bagous diglyptus
„ lutosus †	„ glabrirostris
„ petro †	„ limosus †
Elleschus bipunctatus	„ nodulosus
Tychius 5-punctatus	Tychius junceus
Miarus campanulae ‡	„ squamulatus
„ plantarum	„ tomentosus
	Sibinia primita
Anthonomus pomorum	Anthonomus Comari
	Acalles roboris
Coeliodes geranii	Coeliodes fuliginosus
Poophagus nasturtii	„ rubicundus
Ceuthorhynchus querceti	Ceuthorhynchus litura
	„ euphorbiae
	„ hirtulus
	„ marginatus
Ceuthorhynchideus horridus	Ceuthorhynchideus mixtus
„ hepaticus	„ Dawsoni
„ pulvinatus	„ nigrinus

* Although *Hypera meles* is recorded from both counties it must be regarded with suspicion, since its characters have been so badly defined in British works. The two Norfolk specimens are said to "agree with the descriptions of this species;" and the Suffolk record is Stephens' ('Illustrations,' iv. 99).

† *Bagous lutosus* is not British, and the above record refers to some other species. *B. petro* and *B. limosus* should probably be omitted from *this* list as synonymous.

‡ Stephens' *Gymnetron linariae* in all probability was synonymous with the abundant *G. noctis*.

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Norfolk.	Suffolk.
Tapinotus sellatus	Ceuthorhynchideus posthumus
Rhinoncus bruchoides	Cossonus ferrugineus
Phytobius notula	Rhyncolus ater
,, comari	,, lignarius
,, Waltoni	Stereocorynes truncorum
Baris lepidii	Caulotrypis aeneopiceus
Balaninus betulae	Codiosoma spadix
	Scolytus intricatus
	,, pruni
	,, rugulosus
	Hylastes cunicularius
	,, obscurus
	Hylesinus vittatus
	Hylurgus piniperda
	Xylocleptes bispinus
	Pityogenes bidentatus
Dryocaetes coryli	Dryocaetes villosus

Taking the time-honoured groups individually, the following table will show at a glance the relative distribution of species in the sister counties, so far as is to be gathered from Mr. Edwards' lists and my own book, to which latter several kinds have recently been added and are here incorporated.

Group.	Common to both.	Peculiar to Norfolk.	Peculiar to Suffolk.	Both collectively.	Britain (*circa*).
Geodephaga	160	36	31	227	310
Hydradephaga ...	76	19	6	101	130
Palpicornia	65	9	8	82	95
Brachelytra	293	78	127	498	777
Clavicornia	250	86	76	412	681
Lamellicornia ...	52	4	6	62	90
Sternoxi	32	4	3	39	76
Malacoderma ...	51	6	5	62	91
Teredilia	18	5	12	35	57
Longicornia	27	5	5	37	57
Phytophaga	156	16	26	198	256
Heteromera	51	5	18	74	118
Rhynchophora ...	242	50	71	363	526
Total ...	1473	323	394	2190	3264

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XVI.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1903.

By Frank Leney,
Assistant-Curator of Norwich Museum.

Read 29th March, 1904.

The additions to the collection of Mammalia include male and female specimens of de Winton's Field Mouse (*Mus sylvaticus-wintoni*) from Tostock, Suffolk, presented by the Rev. J. G. Tuck, and a variety of the Weasel (*Mustela vulgaris*, Linn.) from Boyland Hall, given by Colonel Irby. To the Ornithological collection has been added a selection of one hundred and eighty skins from the collection which Major Becher, R.A., presented through this Society, and Mrs. Pinckney has given the Green-backed Gallinule (*Porphyrio smaragdonotus*, Temm.) which was killed at Tatterford, in October, 1877, and recorded in our 'Transactions' for 1877, vol. ii. p. 318. Another valuable addition is the Sabine's Snipe (*Scolopax sabinii*, Vigors) shot at Rainham, October 17th, 1856, and described in Stevenson's 'Birds of Norfolk,' vol. ii. p. 343., given by Mr. Francis Nicholas Smith. Five specimens have been added to the collection of Birds of Prey, with regard to which Mr. J. H. Gurney has kindly supplied the following notes:—"Through the kindness of Mr. P. L. Sclater, late secretary of the Zoological Society, the Norwich Museum has been enriched with a long-sought for desideratum in a very fair example of *Thalassætus branickii*, Tacz.: the Black Sea-Eagle of the Corea, a species which my father never succeeded in obtaining. This fine Asiatic Eagle died in the gardens of the Zoological Society, on March 1st, 1903, probably from a chill, but it had lived there ten years and

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done well in spite of being only partially fed on furred food. Before that, it had been in the Zoological Gardens at Hamburg, to which it was presented by Capt. Dethlefsen in 1887, being then supposed to be a young *T. pelagicus*, the allied species with white shoulders, which it resembles in the immature state.

"My son who saw this Eagle at the Zoological Gardens before I did, described it three months after its arrival in London as having both the feet and beak quite white. When I was able to examine it (June 1894,) its beak was a yellowish horn colour with darker tip, cere and lower mandible very pale yellow, toes the same colour, and eyes dark brown. The plumage was then black all over, except that the under surface of the primaries was slightly 'flecked' with white. In May, 1895, the tail was no longer entirely black. In October, 1896, several of the tail feathers were partly white as well as the upper and under tail coverts. Eventually it assumed a pure white tail, and at the time of its death closely resembled the figure which illustrates Dr. Heinr. Bolau's article in 'Der Zoologische Garten,' (1894). Mr. Sclater has remarked on the small size of this example when it arrived in England (P.Z.S., 1893, p. 613), and as he anticipated, it proved to be a male when subsequently skinned and dissected by Mr. T. E. Gunn, at whose house the following measurements were taken:—expanse, 6 feet 10 inches; length from tip of beak, 3 feet 2½ inches. The opportunity was a favourable one for preserving the sternum which has been compared with the sterna of our two British Eagles *Aquila chrysaëtus* and *Haliaëtus albicilla*. It proved to be larger than either of them, though very like the breast-bone of *H. albicilla* except that it was a little deeper, and the keel somewhat more rounded, without posterior emarginations: ribs seven in number. Length of windpipe, 7¾ inches. One noticeable feature about this Eagle is the great length of the feathers on the belly, some of them measuring as much as 5·2 inches, being considerably more than in the corresponding feathers of *T. pelagicus*.

"With regard to its scientific name this Eagle ought apparently to stand as *Thalassäetus niger* (Heude), for in 1877, P. M. Heude of Zikawei, Japan, described in 'Le Naturaliste,' p. 95, an Eagle of a black colour all over except the tail, which he had alive, under the name of *Haliaëtus niger*, which was no doubt identical with the

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T. branickii named by M. Taczanowski in 1888 (P.Z.S. 1888 p. 451). Of this bird which was from the sea of Tartary (? Kamtschatka), and which was known to be three years old, Heude wrote in 'Le Naturaliste' (1887, p. 95):—"Son plumage n'est pas encore blanc pur aux couvertures caudales. Mais les petites couvertures des ailes, le front, les tibiales, sauf une ligne intérieure, et les quatorze rectrices sont blanc pur. . . . La queue qui n'est pas encore blanche, est longue et effilée, toutes les plumes d'ailleurs sont plus lancéolees que celles de son voisin [*H. pelagicus*]. Il n'a de blanc qu'a la queue; le reste du plumage a toujours été plus noir que brun, et surtout que le brun pâle de *l'H. albicilla*."

"As the Museum only possessed one specimen of *Leucopternis semi-plumbea*, Lawr. procured several years ago ('Ibis' 1893 p. 340), another which has been added during the past year is acceptable. It is adult, labelled a male from N. Ecuador, America, April 10th 1901, received without collector's name through Mr. Rosenberg, of London. *L. semiplumbea* is probably no longer to be considered rare in collections.

"That successful collector, Mr. A. S. Meek having obtained a series of *Ninox jacquinoti* (Bonaparte) in the Solomon islands, an Owl described as long ago as 1850 (Consp. Av. i. p. 42), and then for a time lost sight of (*cf.* 'Ibis' 1895 p. 374), and not represented in the Norwich Museum, I am very glad to fill up the blank by presenting a pair of Mr. Meeks' skins of this Owl, shot on Ysabel island, one of the Solomon group. "The Hon. Walter Rothschild and Mr. Hartert in describing Mr. Meek's collection of birds in 'Novitates Zool.' (ix. p. 592), have some interesting remarks on *N. jacquinoti*, which they seem to view as a very distinct form, nearest perhaps to *N. granti*, but a form subject to a good deal of variation. This is the only Owl which has been added to the Museum collection in 1903."

A well mounted specimen of the Common Boa (*Boa constrictor*, Linn.) has been placed with the Snakes, and a curiously marked variety of the Brill (*Rhombus vulgaris*, Linn.), also a pale coloured Sole (*Solea vulgaris*, Flem.) have been added to the series of local fishes.

The Entomological collection has been augmented by a large selection from the duplicates in the British Museum (Nat. Hist.)

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presented by the Trustees of the British Museum, and Mr. A. J. Fison has also given twenty-three specimens representing twelve species from the Rhone Valley not before in the Museum collection.

A series of specimens illustrative of the marine fauna of the Bay of Naples has been acquired through Mr. F. W. Harmer, who, with Dr. Sidney Harmer kindly selected them while visiting the Zoological Station at Naples. Many of these specimens are objects which on account of their extreme delicacy are not usually found in Museum collections, and others, such as the Red Coral with its extended polyps, are of such striking beauty that they arrest the attention of the most casual observer. The following is a list of the specimens:—*Scymnus lichia* (embryo), *Carcharias glaucus* (young), *Salpa africana-maxima*, *Ascidia mammillata*, *Antedon rosacea*, *Holothuria tubulosa*, *Synapta digitata*, *Echinus acutus*, *Luidia ciliaris*, *Capsa fragilis*, *Cardium aculeatum*, *Tritonium nodiferum*, *Cassidaria echinophora*, *Pterotrachea coronata* (eggs), *Aplysia limacina*, *Argonauta argo*, *Octopus vulgaris*, *Loligo vulgaris*, *Sepia officinalis*, *Spirographis spallanzanii*, *Rhizostoma pulmo*, *Pennaria cavolinii*, *Physalia caravella*, *Astroides calycularis*, *Alcyonium palmatum*, *Pennatula phosphorea*, *Corallium rubrum*, *Euspongia officinalis*.

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XVII.

NATURAL HISTORY NOTES FROM YARMOUTH.

By A. H. Patterson.

Read 29th March, 1904.

1903—1904.

April 28th, 1903. A pair of Nightingales visited St. George's Park, in the centre of the town, on this date; the male bird perching himself on a tree sung for four hours with but slight intervals of rest, to the great delight of numerous admirers.

May 1st. Saw several Lesser Terns (*Sterna minuta*) on Breydon; it is interesting to note their more frequent appearance on Breydon year by year. It is a great pity such exquisite creatures are not scheduled all year round. On the same date a Swallow was observed to fly in straight from sea.

On May 5th, three Black Terns (*Hydrochelidon nigra*) on Breydon; quite a number reported for the Broad district.

Early on May 7th I sailed up amongst the mudflats, observing quite a number of small waders, mostly Dunlins. In the afternoon I put up a young Spoonbill from the edge of a drain, where I discovered him in sociable companionship with a Heron and several gulls. A perfectly "grey" Godwit, and a number of Curlews and Whimbrel were also in evidence. A common Sandpiper (*Totanus hypoleucus*) was also seen. A day or two after I saw fully 500 Ringed Plovers.

May 13th. Three pairs of Swifts (*Cypselus apus*) visited their old quarters—the corner house near the Brick Quay. Their stay this year was remarkable for the almost entire absence of their noisy, rollicking screaming. The cold wet summer evidently damped their spirits, as it did our own. Mr. B. Dye also remarked this peculiarity.

May 16th. Greenshank on Breydon. Two Spoonbills for some days on the flats.

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May 18th. Cuckoo Gurnard (*Trigla hirundo*) weighing 8½lbs. on sale.

May 22nd. Had half-an-hour's extreme pleasure in watching six Spoonbills. They acted very much in unison, both in moving around and in spooning at the drain's edge.

May 14th. A score Grey Plovers flew in this morning.

June 6th. Two Greenshanks on Breydon; these remained with us the whole of the gloomy summer; from their actions and presence I suspected the probability of their nesting, a suspicion further strengthened by observing three young ones with them. (See July 9th).

June 6th. An Avocet, which I did not see, but I can rely on my informant, dropped in amongst some Black-headed Gulls, and remained on Breydon for a few hours.

June 19th. Lemon Sole, 8½ ins. I ate it, but found it insipid and tasteless beside its common relative.

June 21st. Grey Plover on Breydon. Was this a late bird, or an early return?

July 3rd. Two Greenshanks on the mudflats. Eight there on the 4th.

July 9th, my entry reads as follows:—"I am satisfied now that a nest of Greenshanks has been on or near the ronds on Breydon this year. Early this morning, five Greenshanks, three of them very evidently young ones, (their call notes were not pitched quite in the same strong key as their elders) were feeding on the flat a few yards off, in front of my houseboat.

July 9th. Two young Divers, in all probability *Colymbus septentrionalis*, for some days seen on Breydon. Same date I noted the return of the Lesser Terns, and one Common Tern (*Sterna fluviatilis*).

July was not altogether a happy month for outdoor work. Nor had the Swallows a comfortable time of it. On the morning of July 15th, at 6 a.m., I observed a few Blow-flies trying to warm themselves on the boarded fence of the refuse destructor. Two Swallows also noticed them, and kept continually flying up and down, under the shelter of the fence, picking off these insects.

July 16th. Myriads of young Herrings in the river. Length, 1¾ inch. Any bits of floating straw or refuse give them immense fun in flinging themselves over them: this exercise seems to please

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them, whilst the constant flashing of their silvery sides can but attract the notice of the least observant.

July 22nd, early. A Spoonbill, evidently a young one, on Breydon.

On July 23rd, I obtained from a fish hawker a Megrim, (*Arnoglossus laterna*). Length, 4 inches. I cannot guarantee it as a "local" example.

July 31st. From a Shrimper I obtained a slightly damaged, but full grown example of *Axius stirynchus*. Only one of the smaller pincer claws remained. This is the first example of its kind I have known to be taken off this coast.

On August 1st. A quite "grey" Curlew-Sandpiper, with other slightly red examples, feeding on the mudflats. This species does not "prick about" on the surface like the Dunlin, but promptly buries the whole of its beak when probing for marine worms. Each small wader has its peculiarities; the Ringed Plover does a great deal of erratic running, usually trotting three steps and then stopping a moment, seldom covering two feet of mud without a halt. The Dunlin covers more ground in the same time. The Curlew-Sandpiper is the most deliberate, and often withdraws his bill with a patch of mud on his forehead.

August 17th. Young birds moving south. Saw on this date many young Ringed Plovers, Redshanks, and Wimbrels on the flats.

On August 20th, Crab pincer claw with the fixed chelœ, a mere pointed knob, giving the claw when closed a singularly macaw-like appearance! On September 8th, I received a very large pincer claw which had a second fixed *chela* growing out at a right angle, forming, with a third, but smaller point in the angle, a complete W.

Early in August, a Thornback Ray, size of a dinner-plate, was perfectly white on the upper surface, save for a small ring of the normal grey around the eyes.

August 31st. A number of young Lesser Terns, Curlews and Knots on Breydon.

Swifts about until August 31st—my latest noted for some years. Probably the early sitting of eggs being addled by cold weather (a friend of mine stating that several were thrown out from under the eaves of his house), these birds were a late hatch.

On September 2nd, a live Shag brought me which was taken on a fishing boat in the North Sea. Is this species becoming

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commoner as a visitor to Norfolk? It was brought me by a fisherman and was remarkably tame, it allowed me to handle it in such great good nature. It, however, gave me a vicious bite a few days after when I was not on the alert.

September 18th. A Honey Buzzard was shot at Corton. Brownish form. Sex undetermined.

The Bat is learning to adapt himself to altered circumstances. At 9 o'clock on the night of September 21st, a Pipistrelle was fluttering around an electric lamp catching various moths, which at times are seen plentifully dancing around these brightly illuminated globes.

On September 22nd there were numbers of Golden-Crested Wrens (*Regulus cristatus*). The bushes and shrubs in St. George's park alive with them.

September 23rd. A 5 ft. example of the Tope (*Galeus vulgaris*) swimming near the surface of Breydon, was secured by a wherryman. I picked from its side several specimens of fish parasites answering to name of *Pandarus bicolor*.

September 26th. Goodly number of Golden Plovers on Breydon.

"October 19th. Enormous number of Crows, Rooks, Jackdaws, and small birds coming in all day."

"October 20th. Rooks and other *Corvidæ* pouring in to-day in thousands." (Entry in note book).

October 31st. A flight of Long-tailed Tits (*Acredula caudata*) flew heavily in and quite through the town, following the direction of the Market Roads and overtopping the houses went inland.

November 14th. Immense flock of Snipe seen up the Bure; stated to be quite 400. They alighted upon a floating "hover" and literally scrambled for a standing place. On being disturbed by a wherry they flew up noisily, some actually passing between the mast and bobstay.

December 1st. An hermaphrodite Herring, discovered by a local fish merchant when sitting at breakfast.

1904.

January 1st. An Avocet killed near Aldeburgh. I saw this beautiful bird in the flesh and believed it to be a male.

The Waxwing (*Ampelis garrulus*) appears to have been unusually abundant during the winter of 1903-4. I saw several in the market

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at different times; and on January 20th Mr. Barwood, of Horstead Mills, brought me one for identification. Up till January 25th, the Wood Pigeon appeared to be singularly scarce in the neighbourhood.

In the last week in January, a perfectly fawn-coloured Wild Duck and Mallard were brought to market. The speculum was somewhat deeper in colour than the remainder of the plumage. I sent the male bird to Mr. J. H. Gurney.

January 12th. An 11½ inch Sole, with the head of the normal colour, and rest of the upper surface perfectly white, on a slab to-day.

"February 21st. During the first half of the month a flock of between 2,000 and 3,000 Dunlins on Breydon." (Note book). A flock of equal size was seen there on March 14th.

February 22nd. A large company of wearied Rooks and Crows trooped in from the sea on this date: there were hundreds. Wind strong from N.W., force, half a gale. These were in all probability going northwards, and put in for a rest.

February 24th. A specimen of the Ballan Wrasse, of the variety known as *Labrus maculatus* var. *lineatus*, the size of one's hand was taken in a shrimp-net off the Cockle Gat. It was of a beautiful blue-green colour, dotted uniformally with maroon-coloured spots, and streaked similarly on each cheek.

February 28th. First snow of winter.

On February 29th, a 9 inch Plaice with head and a small part of anterior end of normal colour, the rest being perfectly white, brought in. A vivid spot or two of red dotted the white portion.

On March 2nd, on the Fishwharf, I saw a 4 ft. Sea Angler, a Lumpsucker, fully 10lbs. in weight, a large double Turbot, and a perfectly albino Turbot.

March 15th. From amongst a trunk of small fish—Whitings, Gurnards, &c., I obtained on this date a fairly perfect example of the Marbled Swimming Crab (*Portumnus marmoreus*). As this consignment came from an undefined locality in the North Sea, I cannot claim for it a place on my list; on which it is not yet represented.

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THE HCUSE AT SUTTON.

HOTTONIA PALUSTRIS AT SUTTON.

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XVIII.

THE SUTTON BROAD LABORATORY.

THE Sutton Broad Biological Laboratory was founded for study of the Biological conditions of the Norfolk Broads and the connecting rivers. The house was built in the autumn of 1901, and a little preliminary work was accomplished in the summer of 1902; but it was not until 1903, when Mr. Balfour Browne took up the post of director, that any continuous work was undertaken. The Laboratory has accommodation for four workers at a time, and is provided with all necessary glassware and chemicals; and there are three bedrooms available for those wishing to make a stay. It is situated on the edge of the Broad, on a spit of land running out from the uplands into the marshy region, which is known on the Ordnance Map as Longmoor Point, and among the local inhabitants as Gravel Point.

Sutton, or Stalham Broad, as it is wrongly named on the Ordnance Map, was, in former times, a large area of water (about 100 acres), but now, in summer time, it is a waste of reeds, reed mace, and bulrushes, with a great abundance of white Water Lilies and every other kind of water weed; the roots of this vegetation form almost a complete stretch of "hover" over the Broad, leaving only a narrow channel of open water across the length to Sutton Staithe, and a second channel to Stalham Staithe. Dykes lead from the Broad into Sutton Fen, which is a large area of quaking bog and mowing marshes quite unreclaimed, and in winter usually under water. Two miles lower down the river Ant is Barton Broad, which has quite a different appearance, being surrounded on three sides by trees, and having a great deal of open water; from Barton Broad to the junction of the rivers Ant and Bure is about six miles, and from this point access may be had to all the other waters of the Broads district.

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It will be seen at once that in such a district there is no field for the work of the kind, which figures so largely in the reports of freshwater Biological stations on the Continent and in America. There is neither a pelagic nor a deep water fauna; there is only "pond life," and of that there is an abundance in species and in individuals, both of plants and animals; moreover, this water system presents so many and so various features (especially as regards salinity) that we may expect to find a remarkable distribution adapted to the varieties of environment.

The aims of the Laboratory are, first of all, to make complete lists of species to be found in the district, taking group by group, with exact notes of the spots and the months in which each is found, and observations upon the physical conditions. This is a large work, and can only be done by the collaboration of many workers. It is thought that interesting results may be obtained by recording the changes in distribution year by year. Concurrently with this, which may be called the general work of the Laboratory, more special work will be undertaken in the direction of comparative anatomy and life history.

During the past year, Mr. Balfour Browne and Mr. Robert Gurney have been continuously at work in the Laboratory; the former has investigated the distribution of the Dragon Flies, and the latter the distribution of the Copepods and Cladocera. Mr. D. J. Scourfield and Mr. W. R. G. Bond have paid short visits for the purpose of studying the Entomostraca, and Mr. F. J. Hanbury has made collections on the Broad. A large collection of Hydrachnids is being made and sent to Mr. G. D. Soar for identification. Besides the Zoological work, observations are being made on the movements of the water, the salinity, temperature, etc. This summer the marking of fish is being undertaken with a view to tracing their movements and rate of growth.

It is much hoped that this year more workers will make use of the Laboratory; and for the information of these it may be said that it is about two miles by road from Catfield Station, and within twenty minutes by water from Stalham Staithe.—ED.

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THE LABORATORY, SUTTON.

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XIX.

FAUNA AND FLORA OF NORFOLK.

Additions to Part XI., Birds (Fourth List).*

By J. H. Gurney, F.L.S., and Thomas Southwell, F.Z.S.

Read 29th March, 1904.

The following supplement to our list of the Birds found in Norfolk, which was laid before the Norfolk and Norwich Naturalists' Society in 1887, contains mention of such rarities as are of importance which have appeared in this county during the past five years. Should the Lesser White-fronted Goose obtained in The Wash not have been killed on the Lincolnshire side, it is an addition to the birds of the county, and this, with the Sooty Tern, raises the total for Norfolk to 310; or, if we reject Pallas' Shrike (which we accepted in our last list) as an invalid species, it leaves it at 309, a number which will compare favourably with that of any other county in England.

Of these, 107 species may be regarded as breeding regularly in the county; twelve others as occasionally breeding here, and yet another twelve which there is more or less reason to believe have on rare occasions bred here; fifteen species which formerly bred here have ceased to do so, and 164 non-breeding birds are, for the most part, winter immigrants or casual visitors. There are twenty-two others which, for reason of their specific value not being fully recognised, or their claims to have occurred in this county not being entirely satisfactory, we have thought it best not to include in the above estimate.

During a period of five years there have been several important migrations, the last of which, and in some respects the most interesting, took place on the 19th and 20th September, 1903. It consisted almost entirely of small birds of the Passerine order,

* The previous lists will be found in vol. iv. pp. 259 and 397; vol. v. p. 642; and vol. vi. p. 501.

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such as Redstarts, Pied Flycatchers, Robins, Golden-crested Wrens, Warblers, etc., which were observed to be enormously congested for at least forty-eight hours on the line of coast extending from Cley to Holkham Sand-hills. At the same time they were seen in many other places along the east of England; but perhaps nowhere in such profusion as in Norfolk, where they came especially under the notice of Mr. Alexander Napier, Mr. Kay Robinson, and Mr. Pashley. These birds made land with a N.E. wind amounting to a gale; and the same wind but not so strong, prevailed on the eastern side of the North Sea at six stations between Calais and the south of Norway the evening before (September 18th), when the birds would probably have been about to start. By the 21st the bulk had passed either to the south or inland, but Mr. Caton Haigh notified another reinforcement in North Lincolnshire.

Another remarkable migration was that of the *Corvidæ* (principally Rooks) in October, 1902, of which a table showing the dates on which they were observed, with the direction of the wind, and its strength, is given in 'The Zoologist' vol. vii. 4th series, p. 122. These Rooks were going west, and in most cases against the wind, and were particularly observed in the neighbourhood of Wells.

Those species marked with a * are new to the list.

White-tailed Eagle.

An Eagle, doubtless of this species, was killed at Babingley, near Lynn, about 1st October, 1899. This is the seventh Eagle in the last twelve years, the others occurring in November and December. Another seen at Hickling, January 30th, 1903, and afterwards at Melton, was subsequently shot near Ipswich.

Orange-legged Hobby.

On the 30th April, one of these birds was brought to Mr. Lowne of Yarmouth to be preserved, which had been shot at Acle.

Goshawk.

In April, 1901, a female Goshawk, a rare bird in this county, was taken in a Rabbit trap at Weybourne.

Rough-legged Buzzard.

Several were seen or killed in October, 1902, and a few in October, 1903, when a great flight came to Yorkshire.

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MARSH HARRIER.

On the 11th May, 1899, a nest of this bird quite ready for eggs was found in the Broad district, from which the female was seen to rise. Four Harriers were seen on the wing at the same time, one of which was, I regret to say, subsequently trapped. The nest was photographed by Mr. Kearton, and appeared in his 'Our Rare British Breeding Birds.' It is believed to be twenty years since this species last hatched off in Norfolk, but a nest with two eggs was found in 1894.—J. H. G.

TENGMALM'S OWL.

One caught at Thornham, October 30th, 1901. Two others at the same time in Suffolk.

SCOPS EARED OWL.

One of these birds, which allowed close inspection, was seen by Mr. S. J. Hoare at Sidestrand, on 6th April, 1902.

LESSER GREY SHRIKE.

An immature example shot at Docking by Mr. G. E. Lodge, on October 11th, 1902.

WOODCHAT.

On the 2nd June, 1901, a Woodchat was seen at Framingham Earl by Mr. Bligh.

DIPPER.

A Dipper, probably *C. melanogaster*, was seen at Raynham on the 27th February, 1902.

GOLDEN ORIOLE.

In April, 1901, Mr. Lowne, of Yarmouth, received an Oriole which had been shot in the vicinity.

RING OUZEL.

These birds were quite numerous in October, 1902. There were also a good number of "Michaelmas Blackbirds" in October, 1899.

BLUE-THROAT.

Several were seen and one shot at Cley on 9th September, 1900, and others on the 18th and 31st of the same month.

BARRED WARBLER.

One of these birds appeared at Cley on 13th September, 1902, with Blue-throated Warblers and other migrants.

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ICTERINE WARBLER.

On the 5th September, 1899, an immature Icterine Warbler, the fourth which has been obtained in Norfolk, was shot between Wells and Cromer by Mr. E. C. Arnold. Both this and the Buff-breasted Sandpiper recorded below were seen by the writer, by the kindness of Mr. Arnold. Another Icterine Warbler occurred at Blakeney on September 18th, 1903.

AQUATIC WARBLER.

Mr. Gunn shot one of these birds on the 9th September, 1902, at Blakeney, in the same place and almost on the same day (8th September) as he met with a previous specimen in 1896. Another was obtained by him in the same locality on September 18th, 1903.

WAXWING.

Several were seen in Norfolk towards the end of November, 1901, but the birds passed on without making a stay with us. There was another visitation in the winter of 1903, which assumed considerable proportions, reports of seventy being handed in, including what occurred in the north of Suffolk.

LAPLAND BUNTING.

On October 14th, 1899, a Lapland Bunting was taken on the North Denes at Yarmouth.—A. Patterson.

MAGPIE.

This is a rare bird taken as a whole in Norfolk, being most frequently found in the North-west part of the county. On February 4th, 1902, one was seen at Crostwick, and on the 6th of the same month two others at Keswick, the first I ever remember having been seen there.—J. H. G.

NUTCRACKER.

For a week in the early part of May, 1899, a Nutcracker was observed by Mr. Thomas Baring, in a plantation of tall, dark Fir trees near Thetford; it is believed to have escaped molestation.

HOOPOE.

On 18th September, 1899, Mr. Cole received a Hoopoe which had been killed at Skeyton. One was seen on 26th September, 1902, and another September 1st, 1903, at Mautby.

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[GREAT BLACK WOODPECKER.

With reference to the repeated reports of the appearances of this species in England, most of which may at once be dismissed as "unproven," it may be well to put on record a circumstance which has recently come to light. Mr. W. H. Tuck informed me that in the year 1897, seven or eight of these birds were brought from Sweden, where they had been taken from the nest by a friend of his, and after having been kept in an aviary near Brandon for some time were allowed to regain their liberty. This fact is given from his personal knowledge, but he was not allowed to mention the circumstance until a period of three years had expired, and it will doubtless account for the examples reported by the Rev. E. T. Daubeny as seen at Ixworth, Euston Park, and Brandon in 1897, and possibly also for those said by Mr. Digby Pigott to have been seen in Sheringham Park in 1903. That this sedentary species should ever, of its own accord, desert its native forests and migrate hither is so exceedingly improbable, that ornithologists were fully justified in rejecting any but the fullest evidence of the occurrences, and such an introduction as that just mentioned ought to be regarded with reprehension even if conducted openly, much more so if secrecy were enjoined on the part of the few who were aware of the transaction.—T. S.]

ROLLER.

One was brought in the flesh to Mr. Roberts to be preserved, on the 2nd September, 1902, but the carrier who brought it declined to say where it was shot. Another is reported from Rushford, near Thetford, on 9th of September, 1902, and another at Gayton on October 22nd, 1903.

ALLEN'S GALLINULE.

A young bird taken on a fishing boat near Yarmouth, December 31st, 1901, was probably a migrant. It appears that this African Waterhen also generally chooses the winter months in which to visit Southern Europe, and not spring or autumn, as might be expected.—J. H. G.

MOORHEN.

Two fully-grown young Moorhens, in beautiful plumage and pure albinos, were killed on the 1st and 3rd of August, 1903,

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at Rollesby. These both belonged to the same brood, the other members of which I was informed were of the normal colour.—T. S.

LITTLE BUSTARD.

An adult female at Ludham on 26th November, 1900, and a male at Caister, December 11th, 1902; the latter is the usual month for the occurrence of this species here.

AVOCET.

An Avocet was seen on Breydon on 30th July, 1901, and remained there undisturbed, thanks to the watcher, certainly till the 18th of August. Another appeared on June 6th, 1903, but only stopped about two hours.

SOLITARY SNIPE.

Several of these birds were killed in Norfolk and Suffolk in the last two weeks of September, 1899; several were killed in September, 1880.

TEMMINCK'S STINT.

A specimen on the 1st September, 1900, at Cley.

BUFF-BREASTED SANDPIPER.

A beautiful young male was shot by Mr. E. C. Arnold at Cley, on the 8th September, 1899.

WHITE-WINGED TERN (?).

On the 22nd April, 1901, eight of these birds are said to have been seen on Breydon by the watcher; and on 15th May another was seen in the same locality. There is some doubt, however, as to whether they were correctly identified.

CASPIAN TERN.

Mr. Patterson, on more than one occasion on July 21st and 22nd, 1901, watched one of these birds fishing on Breydon; it passed on, thanks to the Wild-birds protection. Another was seen on 24th July, 1902.

ROSEATE TERN.

A Roseate Tern was seen during May, 1902, at Blakeney Point, where it remained until about 31st July, and is believed to have paired with a Common Tern. The same or another appeared again in May, 1903.

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*Sooty Tern.

Early in April, 1900, an adult Sooty Tern was picked up dead at Santon Downham, in Suffolk, within the administrative district of Thetford, and only about a mile from the boundary of Norfolk, by Mr. J. Nunn, at whose house it was recognised as a rarity by Mr. W. G. Clarke, and his identification subsequently confirmed by Mr. Southwell. It is now in the Norwich Museum.—J. H. G.

Great Skua.

This bird is a rare visitor to the Norfolk coast usually in the month of October, but a party of five was seen by Mr. Long on 31st August; and a few days later, a single bird by Mr. T. E. Gunn.

Sabine's Gull.

One of these birds, shot at Lowestoft on 18th October, 1901, was sent to Mr. Cole to be preserved. Another was seen September 3rd, 1903, at Blakeney.

Little Auk.

At the end of February, 1900, and during part of March, there was a great incursion of these birds on the East coast, especially between the Wash and Lowestoft. Very many were picked up dead or dying on the coast, but few proportionately occurred inland. For particulars see 'Zoologist,' 1901, p. 124. A considerable number of these birds also occurred in February and March, 1901. Females appeared to preponderate.

Night Heron.

An adult shot by a gamekeeper at Rollesby Bridge on the 8th November, 1899.

Little Bittern.

On June 3rd, 1899, a Little Bittern was observed at Hickling by Rev. M. C. H. Bird.

Bittern.

The usual Winter Bitterns have been killed from time to time, but on 27th February, 1900, one of these birds was heard uttering its breeding note at Hickling; and again, at the same place, on 5th January, 1901.

Glossy Ibis.

A fine male frequented the meadows on the Bure, near Ludham,

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for some weeks, and was killed on 25th November, 1902. An immature male was shot at Halvergate, August 21st, 1903.

SPOONBILL.

These birds have been seen on Breydon every year, in the early Summer. They were especially numerous in that locality in June, 1900; they made short stays; and in all cases, I believe, were allowed to depart in peace. In the summer of 1901, from April to July, small parties were seen almost daily, and again in 1902 and 1903. The first appearance is always in April.

WHITE-FRONTED GOOSE.

Mr. Napier mentions that there was a very unusual number of these birds at Holkham in the past winter (1903—4). They were there in hundreds, and stayed quite three weeks after the Pink-footed Geese had left. This is the more remarkable, as, with us, this species has always been most abundant in hard weather, and the past Winter has been an exceptionally open one.—T. S.

* LESSER WHITE-FRONTED GOOSE.

A female of this species was obtained in the Wash, and sent from Lynn by a poulterer to Birmingham on 24th January, 1901. The particulars of this, the first occurrence of this species on the Norfolk coast, will be found in the 'Zoologist' for 1902, p. 85.

BARNACLE GEESE.

About 21st December, 1899, flocks of Barnacle Geese were seen on Breydon, Morston, and Cley, and three shot. Flocks of ten and fifteen are mentioned, quite unusual numbers on this part of the coast, where this bird is of rare occurrence.

SHELD-DUCK.

This bird has considerably increased in numbers, and is now fairly plentiful in the breeding season in suitable localities on the North-west Norfolk coast.

NYROCA DUCK.

During April two flocks of Nyroca Ducks—each said to have numbered ten or twelve—visited the Broad district, one at Hickling and one at Rollesby, where they apparently meant to take up their quarters. Unfortunately they were shot at, and some fine old males killed, by persons who defy the law instead of respecting it. Others appeared at the same time in Yorkshire. The Rev. M. C. H. Bird had a view of two of them as late as April 29th, on the Broads.

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XX.

FAUNA AND FLORA OF NORFOLK.

Additions to Part IV., Fishes (Fifth List).

By T. Southwell.

Read 29th March, 1904.

Those marked with a * are new to the County List.

Owing to the regretted death of Dr. John Lowe, by whom the first list of the Norfolk Fishes was prepared for our Transactions and presented in vol. i. (1873) p. 21, followed by continuations in vol. iii. p. 677, vol. v. p. 634 and vol. vi. p. 495, it has fallen to my lot to record the rarer and new species which have been met with during the last five years, and in doing so, I may at once say that in almost every instance the records refer to the marine fishes of the East Coast and are due to the vigilance of Mr. Patterson of Yarmouth. Since Dr. Lowe left Lynn in the year 1885, this branch of the Fauna has been absolutely neglected in North and West Norfolk, which is greatly to be regretted, as the fisheries from Wells and Lynn would, had they been watched with the same assiduity Dr. Lowe bestowed upon them in former times, doubtless have been as prolific in rarities as those of the Eastern Coast. It is to be hoped that some member in that division of the county will take up the work so ably commenced by our late honorary member, Dr. Lowe.

* The Bogue (*Box vulgaris*, Cuv.).

In the middle of December, 1902, a specimen of this fish which had not hitherto, I believe, been recognised in Norfolk waters, was found dead on the beach at Cromer. It measured 9 inches in length and 2¾ inches in depth. It was seen by me in a fresh condition.

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BALLAN WRASSE (*Lambrus maculatus*, Block).

An example of this fish, now in the Norwich Castle-Museum, was taken at Winterton on the 11th June, 1900; a second on 13th March, 1902.

MONTAGU'S SUCKER (*Liparis montagui*, Donov.).

I have frequently seen this fish from North and West Norfolk, but Mr. Patterson tells me that he had not met with it at Yarmouth till the present spring (1904), when, on separate occasions, three, two of which were full of spawn, were brought to him early in March.

SCRIBBLED MACKEREL (*Scomber scombrus*, Lin., var. *scriptus*).

A specimen in the Norwich Museum was sent from Yarmouth by Mr. Patterson, on 26th November, 1901. Several other examples have been observed here.

* GATTORUGINE (*Blennius gattorugine*, Block).

On 25th May, 1899, Mr. Patterson sent me a specimen of this fish, which had been taken on the 21st of that month by a Yarmouth shrimper; this, I believe, was the first recognised instance of the occurrence of this species on the Norfolk coast. It was mentioned by Dr. Lowe in a foot-note to his last list. See vol. vi. p. 500.

POWER COD (*Gadus minutus*).

Mr. Patterson records one 8 inches long taken in a shrimp-net at Yarmouth, on 13th May, 1901.

A HYBRID TURBOT-BRILL, now in the Nat. Hist. Mus. South Kensington, was obtained by Mr. Patterson in January, 1902.

* EKSTROM'S TOPNOT (*Zeugopterus unimaculatus*, Moreau).

In September, 1902, an example of this fish, which had been hung over the mantel-piece of a Yarmouth shrimper, was given to Mr. Patterson, and, although in a dried state, there was no difficulty in determining the species. It was about 5 inches in length.

MULLER'S TOPNOT (*Zeugopterus punctatus*).

A specimen, 7½ inches long, now in the Yarmouth Museum, was taken on 27th March, 1902.

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* MEGRIM (*Arnoglossus laterna*, Günther).

This is another fish, the recognition of which is due to the watchfulness of Mr. A. Patterson, of Yarmouth. This, the only specimen which has been recognised as occurring in this county, so far as I am aware, was brought to him by a fish-hawker at Yarmouth on 23rd July, 1903. It measured 4 inches in length.

SALMON (*Salmo salar*, Linn.).

The taking of a Salmon, with a fly, in a Norfolk river, is worth recording; such an event occurred on the 20th May, 1897, when one weighing 6 lbs. was captured in the Stoke river by Mr. Geoffrey Fowell Buxton. It has deservedly found a place in the Norwich Castle-Museum.

HERRING (*Clupea herangus*).

A bi-sexual herring was sent me by Mr. Patterson on 29th January, 1902 (*see* Ann. and Mag. Nat. Hist. ser. 7, ix. p. 195). Another example is mentioned in the 'Norwich Mercury' of December 13th, 1902. A third instance was noted at Yarmouth in December, 1903.

PILCHARD (*Clupea pilchardus*).

An infrequent visitor to our coast; three were taken in a draw net on Yarmouth beach, on 3rd June, 1899.

STURGEON (*Acipenser sturio*, var. *latirostris*, Parnell).

The broad-nosed variety of the Sturgeon is much less frequently met with by our fishermen than the normal form *A. sturio*; one is recorded by Mr. Patterson as brought into Yarmouth on 23rd November, 1899.

PLANERS LAMPREY (*Petromyzon branchialis*, Lacép).

On the 10th April, 1900, Mr. Patterson found an example of this fish, 4½ inches long, on the South beach at Yarmouth.

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XXI.

FAUNA AND FLORA OF NORFOLK.

Additions to Part XII., Coleoptera (Third List).*

By James Edwards, F.E.S.

Read 29th March, 1904.

The seven species of Coleoptera enumerated below are all the additional ones that have come to my knowledge as occurring in this county since my list of 1899 (vol vi. p. 515).

Lathridiidæ.

Lathridius bergrothi, Reitt. One specimen by sifting rubbish in a mill-house at Wells, in October (Joy).

Telephoridæ.

Malachius viridis, Fab. Not uncommon in flowers on the sand-hills at Hunstanton (Thouless).

Anobiidæ.

Ptinus sexpunctatus, Panz. One example beaten from Poplar at Norwich (Thouless).

Œdemeridæ.

Œdemera virescens, Lin. This species used to be taken by Mr. Thouless and myself in Foxley Wood; at present (like *Hesperia alveus*, which occurred in approximately the same district) it is not otherwise known as a British insect. The females, apart from the males, are not to be distinguished from those of *Œ. lurida*; under which name my specimens were previously recorded. *Cf.* Ent. Mo. Mag. vol. xxxix. p. 64.

* The lists to which the present is supplementary are to be found in these 'Transactions' vol. v. p. 427 and vol. vi. p. 515 respectively.

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CURCULIONIDÆ.

CEUTHORRHYNCHUS ANGULOSUS, Boh. Lynn (Atmore), one example determined by Newbery.

CERAMBYCIDÆ.

TETROPIUM CASTANEUM, Lin. Near Lynn, two examples, June and July 1903 (Atmore).

CHRYSOMELIDÆ.

PHYLLOTRETA FLEXUOSA, Ill. I find that I have a few examples of this rarity, taken at Brundall, 18th May, 1883.

The following are additional records for rare or interesting species:

HYDROPHILIDÆ.

CERCYON DEPRESSUS, Steph. Yarmouth (West).

SILPHIDÆ.

HYDNOBIUS PERRISI, Fair.
,, PUNCTATISSIMUS, Steph. } Sandhills at Wells in October (Joy).

HISTERIDÆ.

GNATHONCUS NANNETENSIS, Mars. (ROTUNDATUS). In an old tree in a garden at Norwich, 1903 (Thouless).

NITIDULIDÆ.

RHIZOPHAGUS PARALLELOCOLLIS, Gyll. Norwich Cemetery (Thouless).

CRYPTOPHAGIDÆ.

CRYPTOPHAGUS POPULI, Payk. Several specimens from an old gate-post at Wells, in October (Joy).

EROTYLIDÆ.

TRIPLAX RUSSICA, Lin. Dunston (Thouless).

ELATERIDÆ.

ELATER BALTEATUS, Lin. Horsford, June, 1902 (Thouless).

DASCILLIDÆ.

DASCILLUS CERVINUS, Lin. Narborough, Hunstanton, not uncommon (Thouless).

TELEPHORIDÆ.

EROS MINUTUS, Fab. Narborough (Thouless).

CLERIDÆ.

CLERUS FORMICARIUS, Lin. Horsford, June, 1903 (Thouless).

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CERAMBYCIDÆ.

MONOHAMMUS SUTOR, Lin. One example, 3rd July, 1903, in the early morning, on the doorstep of a house at New Town, Yarmouth (West).

CHRYSOMELIDÆ.

HÆMONIA CURTISI, Lac. Cley, on submerged *Potamogeton pectinatus*, about 1839 (Prof. Babington, *fide* Sharp).

XXII.

FAUNA AND FLORA OF NORFOLK.

ADDITIONS TO PART VIII., HEMIPTERA (FIFTH LIST).*

BY JAMES EDWARDS, F.E.S.

Read 29th March, 1904.

THE following species have not been previously recorded in the 'Transactions' of this Society as occurring in the county of Norfolk.

COREIDÆ.

PSEUDOPHLÆUS WALTLII, H.S. West Walton, 5th August, 1901, at roots of grass in a very dry place (Thouless). This name should be read *antea*, vol. iii. p. 704 and vol. iv. p. 708, instead of *Bathysolen nubilus*.

CORIZIDÆ.

CORIZUS HYALINUS, Fab. One example, taken whilst sunning itself on the Cemetery wall, Norwich, 3rd October, 1903 (Thouless). The only other British specimen hitherto recorded was taken in a marshy place near Gosfield, Essex.

* The lists to which the present is supplemental are to be found in these 'Transactions' as follows: vol. iii. p. 700; vol. iv. p. 702; vol. v. p. 650, and vol. vi. p. 528.

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ARADIDÆ.

ARADUS DEPRESSUS, Fab. Whitwell common, 1st June, 1903 (Thouless).

The following are additional records for rare or interesting species :—

SCUTELLERIDÆ.

PODOPS INUNCTA, Fab. One example in his garden at Heigham (Thouless).

COREIDÆ.

CŒREUS DENTICULATUS, Scop. West Walton, 5th August, 1901 (Thouless); one only.

CORIZIDÆ.

THERAPHA HYOSCYAMI, Lin. One example in his garden at Heigham (Thouless).

BERYTIDÆ.

BERYTUS MINOR, H.S. } West Walton, 5th August, 1901
„ CRASSIPES, H.S. } (Thouless).

HETEROGASTRIDÆ.

HETEROGASTER URTICÆ, Fab. In his garden at Heigham (Thouless).

PACHYMERIDÆ.

APHANUS LYNCEUS, Fab. West Walton, 5th August, 1901 (Thouless).

REDUVIIDÆ.

CORANUS SUBAPTERUS, De G. With the last (Thouless).

NABIDÆ.

NABIS BOOPS, Schiödte. With the last (Thouless).

CIMICIDÆ.

CIMEX PIPISTRELLI, Jen. Three specimens from the hollow of an old tree which had been inhabited by Bats, in a garden at Norwich, September 1903 (Thouless). This is a most interesting capture. The species is extremely rare in collections; not so much, possibly, from the actual paucity of specimens as from the fact that few entomologists ever have the opportunity to search for it under conditions tending to success.

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XXIII.

FAUNA AND FLORA OF NORFOLK.

Additions to Part VI., Flowering Plants and Ferns.*

By W. A. Nicholson, *Hon. Sec.*

Read 29th March, 1904.

The following list contains a few additions to the Flora of the county; also, some new stations for plants already recorded but of sufficient rarity to be worthy of notice.

Those new to the county are marked with an asterisk.

The occurrence of *Barbarea intermedia*, Bereau, is of some interest, as it is only recorded for thirteen vice-counties, in the ninth edition of the London catalogue. This was submitted to Mr. Arthur Bennett for confirmation.

A revision of the genus *Euphrasia* has necessitated a closer examination of the species generally recorded as *E. officinalis*, L., in Norfolk. Mr. A. Bennett considers that the genus requires study in this county.†

SECTION I.

DICOTYLEDONOUS PLANTS.

Ranunculaceæ.

*Ranunculus acris, L. var. b. Borœanus (Jord.)
Hickling Marshes, 1902.
Mr. Cotton. Watson, Bot. Exch. Club Report, 1902–3.

* This list is supplementary to those of "Flowering Plants and Ferns," by the late Herbert D. Geldart, which have appeared in vols. ii. pp. 71, 229; iii. p. 719; iv. p. 711; v. p. 653. Mr. A. Bennett has kindly examined the list, before printing.

† The 'Journal of Botany' for 1897, vol. xxxv. contains a series of papers, with illustrations, on the "British Species of Euphrasia," by Mr. F. Townsend.

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FUMARIACEÆ.

FUMARIA DENSIFLORA, D. C.
Strumpshaw, Mr. F. Long.
Sutton, Messrs. Bennett and Salmon. Journ. Bot, vol. xli., 1903, p. 202.

CRUCIFERÆ.

*BARBAREA INTERMEDIA, Boreau.
Near Ranworth, Mr. F. Long.

ARABIS PERFOLIATA. Linn.
Postwick, 1896, H. D. Geldart (Watson Bot. Exch. Club Report, 1896–97, p. 2).
Bawburgh, Mr. F. Long.
Crostwick to Beeston, Rev. E. F. Linton. Journ. Bot., 1900, p. 209.
Between Horstead and Frettenham, plentiful, C. E. Salmon (Journ. Bot. Mus., 1902, p. 95).

* CARDAMINE PRATENSIS, L. var. palustris (Peterm.), f.
Arminghall, Mr. F. Long.

* ,, IMPATIENS, L.
Shropham, 1886, Rev. M. C. H. Bird.

VIOLARIEÆ.

VIOLA REICHENBACHIANA, Bor. = V. sylvestris, Reich.
Dubeck in Thurne, A. and J. Bennett.

LEGUMINOSÆ.

GENISTA TINCTORIA, L.
Cawston, Rev. M. C. H. Bird.

ROSACEÆ.

* RUBUS HIRTIFOLIUS, M. and W. var. mollissimus, Rogers.
Dersingham Heath, 1st Sept., 1902, Mr. A. B. Jackson (Bot. Exch. Club, Brit. Isles' Report, 1902, p. 42).

COMPOSITÆ.

* ASTER TRIFOLIUM, L. var. discoidea.
Near Hunstanton, 1902, Mr. A. B. Jackson (Bot. Exch. Club, Brit. Isles' Report, 1902, p. 46).

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ERIGERON CANADENSE, L.

Near City Station, Norwich, and Kett's Hill, Mr. F. Long.
Coltishall, Stalham, Messrs. Salmon and Bennett (Journ. Bot., 1902, p. 97).
Ryburgh, 1896; Hunstanton, 1902, Rev. W. E. Thompson (N. and N. Trans. vol. vii. p. 520).

CARDUUS TENUIFLORUS, Curtis.

Thurne, sparingly, A. and J. Bennett, 1903. Rarely so far inland.

TRAGOPOGON PORRIFOLIUM, L.

Stalham, Mr. W. A. Dutt.

ERICACEÆ.

PYROLA ROTUNDIFOLIA, L.

Sutton, Mr. Robert Gurney, 1903.
Dubeck in Thurne! C. E. Salmon.

PYROLA MINOR, L.

Stoke Holy Cross, Mr. F. Long, 1903.

SCROPHULARINEÆ.

SCROPHULARIA VERNALIS, L.

Shropham, 1886, Rev. M. C. H. Bird.

EUPHRASIA NEMOROSA, H. Mart.

Gallow Hill, Burnham.
Southrepps Common, 1900, H. D. Geldart, sp.
N.E. of Thetford, Rev. E. F. Linton (Journ. Bot., 1900, p. 267).
Newton St. Faith's, H. D. Geldart (Watson Exch. Club Report, 1901–2).
Thurne, Mr. A. Bennett. Cley, W. A. N.

* ,, ROSKOVIANA, Hayne.

Stratton Strawless, H. D. Geldart (Watson Exch. Club Report, 1901-2).

* ,, BREVIPILA, B. and G., f.

Felthorpe, H. D. Geldart (Watson Exch. Club Report, 1901-2).

* ,, KERNERI, Wett.

North Wootton Heath, 1882, Mr. Southwell.
Burnham Deepdale Downs, H. D. Geldart, sp.

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EUPHRASIA KERNERI, Wett.

Weybourne Pits, 1903, W. A. N. Named by Mr. F. Townsend. Hitherto only recorded for Kent, Sussex, and Surrey.

CHENOPODIACEÆ.

* CHENOPODIUM URBICUM, L. b, intermedium, Moq.

Filby, Mr. F. Long.

SECTION II.

MONOCOTYLEDONOUS PLANTS.

LILIACEÆ.

ALLIUM VINEALE, L. b, bulbiferum, Syme.

Near Ingham, Messrs. Salmon and Bennett, in Journ. of Bot., vol. xl. p. 49.

Also, Mr. W. A. Dutt, in two localities in Ingham.

Sprowston, "usually the form *bulbiferum*. Remarkably rare in the county," Rev. E. F. Linton (Journ. Bot., 1900, p. 270.

TYPHACEÆ.

SPARGANIUM NEGLECTUM, Beeby.

Hempstead, H. D. Geldart!

NAIADACEÆ.

POTAMOGETON COLORATUS, Hornem.

Hickling Broad, 1901, T. A. and C. Cotton (Watson, Bot. Exch. Club Report, 1901–2).

CYPERACEÆ.

CAREX LIMOSA, L.

Dubeck in Thurne, C. E. Salmon.

GRAMINEÆ.

* AGROPYRON PUNGENS, Roem. and Schult. c. pycuanthum, Gr. and Godr.

Wells, Mr. F. Long

Titchwell, Rev. W. E. Thompson.

N. and N. Nat. Trans. vol. vii., p. 524.

FILICES.

ASPLENIUM ADIANTUM NIGRUM, L. var. acutum, Poll.

Near King's Lynn, collected by B. Bray. Dr. J. Lowe in Trans. Bot. Soc. Edin., vol. xii., p. 184, 1874.

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XXIV.

MISCELLANEOUS NOTES AND OBSERVATIONS.

Occurrence of the Sooty Tern in Suffolk.—The Sooty Tern (*Sterna fuliginosa*) which I have the pleasure of exhibiting this evening was found on Santon Downham Heath, in the early part of April, 1900, by Mr. J. Nunn, of Little Lodge Farm, Santon Downham. He was rabbiting with a companion when they saw the bird lying dead on some bracken about a quarter-of a-mile from Thetford Warren—which is in the administrative county of Norfolk —and half-a-mile from the Thetford to Brandon highway and the river Little Ouse. The weather was fine and the bird quite dry when picked up; it was taken to Mr. F. J. Rix, Abbey Green, Thetford, to be stuffed, who found it very much decomposed and it must have been dead five or six days at least. It was in very poor condition, with nothing in the crop or bowels but dark, clayey moisture. There were no marks of shot or any wound upon the skin. When mounted the bird was returned to Mr. Nunn.

In the early part of September, 1903, Mr. W. A. Dutt and I stayed a few days at Little Lodge Farm, as a centre for Neolithic flint implement hunting expeditions, and noticed the bird. Though certain that it was a rarity, we were unable accurately to identify it. I took a description, and on my return to Norwich had little difficulty in identifying it as a Sooty Tern.

Only three specimens of this bird had previously been recorded for the British Isles, and three others for the whole continent of Europe. This is the first record either for Norfolk or Suffolk. Though fairly common in the southern hemisphere, it is very rare in the northern. Its nearest breeding stations are on the island of St. Helena and at the southern end of the Red Sea. The recorded British occurrences were at Tutbury, near Burton-on-Trent in 1852; near Wallingford, Berkshire, in 1869; and near Bath in 1885.

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The specimen was subsequently purchased by the Norwich Castle-Museum Committee, re-stuffed by Mr. Gunn, and placed in the British Bird room.—W. G. Clarke.

Wolferton Wild Birds' Protection Society.—It seems to me that the accompanying short report, showing the good effect of preserving Wild Birds is worth printing.

The Wolferton Wild Birds' Protection Society was started two years ago by Mr. George Cresswell and myself, and we were fortunate enough to secure the active co-operation of His Majesty the King as a subscribing member. His Majesty took a personal interest in the matter, as the protected breeding ground is on the shore of the Wash abutting on the Sandringham Estate. We put on a watcher during the nesting season, from the middle of April to the middle of July, with the result given in the report.—Hamon le Strange.

Secretary's Report of the Wolferton Wild Birds' Protection Society for 1903.

Patron: H.M. the King.

"The nesting season of 1903 was, notwithstanding the cold spring, a very good one, and the colony of Tern, both Common and Lesser, has increased considerably during the last two years. Perhaps the most noticeable increase of all is in the Ringed Plover, which, owing to protection, is now becoming numerous and nests freely. Many more ducks nested on the ground protected by the Society than have ever done before. These comprised Wild Duck, Teal, Shoveller, and Shielduck, and I am glad to be able to report that a Gadwall nested for the first time. Owing to the exertions of the watcher (W. Pooley) very few of the early Green Plover and Ringed Plovers' eggs were carried off by Grey Crows this year. I regret to report that W. Pooley was taken seriously ill during the last fortnight of the season and is now in the West Norfolk and Lynn Hospital.—Signed, G. Cresswell, *Hon. Sec.*"

[The report from the Wells Society is equally good, and I am informed that not a gun was fired on Breydon during the close season, notwithstanding the visits of many rare birds.—Ed.]

Ostrea angulata.—Specimens of *Ostrea angulata* were obtained

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from Periwinkles exposed for sale in Lynn. Mr. E. G. Barrett, who was kind enough to name them for me, says this species which is an introduction from Portugal has established itself at Burnham-on-Crouch. These present specimens came from the Thames Estuary. It is worth bearing in mind that *Ostrea angulata* may extend its distribution to the Norfolk Coast.—C. B. PLOWRIGHT, M.D.

GRANITE BOULDER IN THE PARISH OF GUIST, NORFOLK.—Situated in a small gravel pit on the Sennowe Estate lying about 400 yards S.W. of the Ordnance Arms public-house, on the Guist and Fakenham road. The boulder is 4 ft. 3 ins. long by 3 ft. 8 ins. wide at the widest, at the west end it is 2 ft. 6 ins. in height from the ground and at the east end 1 ft. 4 ins. The longer axis of the boulder lies W.S.W. and E.N.E. A small chip of it which was sent to the Geological Museum in Jermyn Street was said to be probably Scandinavian granite. When the sun is low the striations are very well marked by the shadows; it is almost smooth on the upper surface and seems to be resting on the ground and not deeply embedded.—C. A. HAMOND.

LEAVES FROM AN OLD DIARY, *ante*, p. 453.—Referring to the Rev. Dr. Sutton's contributions to Botanical Science (p. 455 second paragraph) Mr. Arthur Bennett is good enough to send me the following note. "You may like to know that Dr. Sutton contributed to Sowerby's English Botany describing plates No. 20—568, &c. There is an obituary notice of him in the Linnean Society's proceedings, vol. i. p. 341, May 2nd, 1848. His papers are also given in the Royal Society Catalogue of Scientific papers, vol. v. p. 889. A. Richard established the genus Suttonia in his honour. The other numbers of English Botany that he contributed to were plates 41, 178, 398, 423, 562, 574, 782, 1691."—T. SOUTHWELL.

EMYS ORBICULARIS—THE EUROPEAN POND TORTOISE.—A specimen of this Tortoise was brought to me on February 19th, by a man working upon the Ludham marshes. It was dug out of the peat, where it was evidently hibernating. This species is no longer a native of Great Britain, although once upon a time it was an inhabitant of East Anglia, specimens having been found in the peat of the fens of Norfolk and Cambridgeshire contemporary with the bones of the Beaver, Roedeer and Pelican (Gadow). Although reptiles are noted for longevity, it is scarcely probable

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that the specimen dug up at Ludham in 1904 is a surviving relic of the native race of post glacial times.

Large numbers of individuals of this species are annually imported into this country from Southern Europe along with *Testudo græca* and sold as pets, and it is probable that the specimen from Ludham has escaped from captivity, or possibly —as was suggested by Mr. Southwell—is one of a number which were "put down" in the marshes some years ago in the hopes that the species would again become acclimatised.—F. Balfour Browne.

Pond Life Notes of the Yarmouth District in 1903.—The unsettled weather during the summer of 1903 made pond collecting somewhat unsatisfactory, although some good results were obtainable. The inconstancy of species in the various localities and hunting grounds has been more apparent than ever, especially in regard to *polyzoa*, *hydra*, *volvox*, and some of the *rotifers*.

Polyzoa: *Lophopus*.—This form has been procurable in abundance in the river Yare, especially at Brundall and Surlingham, although in each case there has been a shifting of the actual ground space occupied in former years. Contrary to many text-books I have found *Lophopus crystallinus* on any and every kind of aquatic plant from Anacharis to the Water Lily and on other objects from a snail-shell to a caddis-case.

Cristatella.—This beautiful polyzoon found in great profusion at Brundall last year and in previous years on the Norwich side of Surlingham was not found by me in either habitat last year (1903). I believe this to be due in a large measure to the action of the tides which carry and distribute the statoblasts in all directions.

Referring to *Lophopus*, I am of opinion that the tidal river is its natural habitat, but during the year I found it in plenty in a ditch at Yarmouth, wholly unconnected apparently with a river stream. The specimens were slightly larger than the river denizens and in larger colonies as a rule.

Volvox globator.—This fitful habitant of our ponds and ditches has been somewhat difficult to find in the Yarmouth district during the past year. I visited every ditch (some dozen or so) where it had been taken in various preceding years but could not find it until chance took me to a West Caister (Yarmouth) ditch in November, when I was rewarded with a numerous catch. I had not taken it in this locality previously.

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HYDRA.—This inhabitant of the ponds and ditches has not been so plentiful in my district, and *Hydra viridis* has been conspicuous by its absence in most ditches. I find that a fair quantity of Entomostracan life is favourable to Hydræ of all species.

ROTIFERA.—These have been plentiful in all species previously notified, but there being in this particular district no other collectors that I am aware of, I am not able to compare notes with other observers. Particular species have been fairly constant in the Rollesby and Filby Broads, but in the smaller habitats the comparatively low prevailing temperature of the summer months was fatal to a large number of species.

Personally, I shall be greatly obliged to any observer and collector of pond-life who will send me the results of work in his particular district with a view to increase the list of species in the various genera already noted.—H. E. HURRELL.

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